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DO YOU KNOW . . . .

► . . . . That strenuous efforts are being made to have the 1957 Yearbook and Membership Directory as correct as possible? We should be able to do a better job than last year because so many of you corrected your addresses when the dues notice was returned with your payment. Also, the post cards for the Directory data this year asked you to check your listings and inform us of changes. We hope you really did "look yourself up."

About 45 to 50 per cent of the cards returned indicate a change, promotions being the most common. In addition, the listings under the Geographical and Occupational headings are being checked against the Alphabetical—a real job! The final check to be made will be the mailing list of Lancaster Press against our membership list. That is about as much as we can do; the rest is up to you, for unless you have informed us of changes we cannot make them. In an attempt to make certain the great number of changes will not be a cause for delay in getting out the February, Yearbook and Directory, issue of the JOURNAL, the first 3000 changes were sent to the printer in August. Now the additional 4500 changes are being made, and Lancaster will set the final type for the revision.

The omission of Industrial Engineering from the list of occupational fields on the Directory data card was entirely accidental. The classification is not being eliminated; a letter has been sent to all under that listing, and apologies have been extended.

► . . . . That it is helpful if you will submit the names of deceased members to the office of the Secretary? It is always embarrassing to receive from the families of deceased members replies to dues notices saying, ". . . passed away over a year ago. . . ." Don't rely on the other fellow to do it; it is better that we receive ten letters about one member than none.

► . . . . That the brochures describing the YET Paper Contest were mailed in late September? This is much earlier than last year because we really want to have a good contest this year—an improvement both in numbers and quality of entries. Copies went to all deans, members of the YET Committee (if the Section informed us of selections), Section Chairmen, and all members of the General Council. Successful Section Contests must be recognized as important Section activities, and Section officers as well as YET Committee members must accept responsibilities for promoting the contest. There is supposed to be an active YET representative or sub-chairman in each institution. He should be active in promoting the paper contest as well as a membership drive. If you can't get a brochure from the local YET representative, the YET Section chairman, from the Section chairman, or from your Dean, copies can be obtained by writing to the Secretary.

► . . . . That one of the National officers hopes to attend most of the Section meetings? The President can't get to all of them—time and money

do not permit. The major exceptions to this effort at representation will be for those meetings on the week-end of April 26 and 27, when the Executive Board will be meeting with the Ohio Section; the other two meetings on those dates can't be attended.

► . . . . That the Minutes of the Executive Board meeting of September 15 are on p. 271? Highlights are the proposed programs of the Atomic Energy Education Committee and President W. L. Everitt's proposal of a new major project of the Society, currently called Procurement and Training of Adequate Staff. Dean H. L. Hazen of Massachusetts Institute of Technology has agreed to serve as chairman of the committee, and plans are developing for the establishment of a top-level advisory group to develop plans and objectives for submission to the General Council; a working committee will be established later.

► . . . . That a "fill in" type of report is being prepared for Section Chairmen? Information regarding Section Meetings has been judged inadequate by both the Vice President in Charge and the Secretary's office. The report will be prepared in duplicate at the close of the Section activity year, one copy going to the appropriate Vice President and the other to the Secretary. Sections may wish to keep copies, too, as summary records of Section activities, officers, and organization—something which many Sections have been needing through the years.

► . . . . That there is a certainty of only one Summer School for 1957? Aside from that for surveying, it begins to look as though no other will materialize. The Minutes on p. 272 bring the status of YET and Humanistic-Social summer-school proposals up to date. It would be nice to hold them in '57, but it is better to have a sound proposal, thoroughly developed, than an earlier program inadequately planned.

► . . . . That the College-Industry Conference in Los Angeles on January 30 and 31 should be one of the best in the history of the Relations With Industry Division? The theme is "Improvement of the Engineer—A Dual Responsibility of the Engineering College and of Industry." The program goes something like this:—*The Engineer:* what he should be, what he is, the educational phase of improvement, the professional phase of improvement, how improvement can be accomplished, and what will it cost? As the name "college-industry" implies, the speakers will be about equally divided between academic and industrial backgrounds. Watch other issues of the JOURNAL for more specific information.

► . . . . That ECPD has printed the following numbers of booklets during the past year?

The Second Mile	10,000
Canons of Ethics for Engineers	3,000
Professional Guide for Junior Engineers	5,200
Engineering—A Creative Profession, 3rd edition	100,000
Manual for Engineering Career Advisors	5,000
Reading List for Engineers	5,000
Personal Appraisal Form for Junior Engineers	2,000
Annual Report	5,000

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THE BACKGROUND OF "SISTER UNIVERSITY" CONTRACTS BETWEEN AMERICAN AND FOREIGN UNIVERSITIES

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For presentation as the opening paper at the ECAC Conference on International Relations, Annual Meeting, June 27, 1956

No doubt there are some experts on sister-university contracts here this afternoon besides those on the program, but many in the audience may not be entirely familiar with this recent development in American foreign policy and higher education. For this reason it seemed advisable for the chairman of the Conference to sketch a brief background for this entire activity before introducing the speakers on case studies.

"University contracts abroad" are a part of the implementation of our national foreign policy of technical assistance to under-developed countries. The aim is to strengthen college teaching, research, and extension work in these countries, primarily in agriculture, education, and engineering, and to a lesser degree in public administration, business administration, public health, and a few other fields.

The extent of this program at present is greater than many university people realize. Early this year authoritative information about it was published in Vol. 12, No. 5 of *Higher Education* issued by the U. S. Department of Health, Education and Welfare. Dr. J. Russell Andrus, University Contract Coordinator of the International Cooperation Administration, which is a semiautonomous unit of the State Department, gave a list of the contracts then in force from which the following figures have been obtained. Some of the contracts then listed may now be terminated, but an even greater number of new ones have been signed. There were at that time 77 contracts in all fields with about fifty different universities and colleges. There are several schools which have more than one contract, since the relationship with each foreign university or U. S. Operations Mission is the subject of a separate contract. More than one field may be covered in a single contract; for example, the University of Wyoming has a contract in Afghanistan covering agriculture, engineering, and other related fields.

Subdivided in geographical areas in order of number of contracts, we find:

The Near East, South Asia and Africa	34 contracts
Latin America	21 contracts
Far East	17 contracts
Europe	1 contract

There were also four contracts with regional U. S. Operations Missions in Latin America and the Near East. The services rendered under these may be distributed to several different institutions in more than one country.

In a total of 77 contracts, the number of times each of the main fields is

mentioned is as follows:

Agriculture	29
Education	29
Engineering	17
Public Administration	9
Business Administration	7
Public Health	2
(Several Others—1 each)	

The ASEE interest is, of course, in the 17 places in which engineering appears. The countries in which these contracts to develop engineering instruction are located, and the American university involved, listed alphabetically by countries were:

Afghanistan—University of Wyoming
British Guiana and Jamaica—
University of Maryland
India—University of Illinois
India—University of Wisconsin
India—Ohio State University
Indonesia—University of California
Kenya—Rutgers University
Korea—University of Minnesota
Pakistan—State College of Washington
Pakistan—Texas A.&M. College System
Pakistan—Colorado A.&M. College
Philippines—Stanford University
Peru—
University of North Carolina (2)
Taiwan—Purdue University
Thailand—University of Texas
Turkey—University of Nebraska

Of the 16 different schools involved in engineering contracts, we have on the program this afternoon three—not too small a sample size, as educational statistics go these days.

The objective of educating a group of key professors and administrators in a particular foreign university is undertaken by an American university on the basis of a three-year contract with the ICA, the International Cooperation Administration. The government funds involved pay the travelling expenses, living allowances if any, salary, and for a few American professors or administrators to go to the foreign university and reside there for whatever period appears to be necessary; and for selected members of the faculty and administration of the foreign school to come to the United States to study for periods up to a year. In a few cases additional money has been made available to cover books for libraries, and apparatus for laboratories.

In essence the arrangement seems simple, straightforward, and practical. The foreign school requests help for specific areas from official representatives of the United States residing in its country. An American university that could handle the request adequately is nominated. A representative of the school makes an "on-the-spot" inspection of the sister institution abroad, and confers with its administrators and with the U. S. government representatives there who are familiar with the local situation. On his return to the United States the university representative makes a report on the feasibility of his institution's participation in the project to the head of his university. The administration and board of trustees then decide whether or not to undertake the contract, if one can be drawn that will be satisfactory to the foreign university, its government, the U. S. Operations Mission in that country, and the ICA in Washington. Since this entire activity is handled in a permissive way, it may take many months to put a contract in such shape that the parties previously mentioned will approve it.

Perhaps it would be well at this point to emphasize that the primary purpose of these contracts is to pro-

vide advice and assistance in the school's program planning, or in the design of new laboratories or experimental facilities, or in the development of methodology for particular courses appropriate to the country. Courses taught by professors of the American team, while in residence abroad, are incidental or secondary. This does not mean that they are not important. On the contrary, program planning is difficult if an American teacher has not had some actual classroom contact with students in the foreign school. The staff members of the foreign university may spend all their time in the United States in observation and study at the sister institution here, or they may visit several schools.

It is not hard to imagine that the day-to-day administration of these "sister-university" contracts provides difficulties of many sorts. First of all, those contracts are a part, perhaps a small part, of total American foreign policy in a given country, and as such, activities under the contract must be coordinated with other U. S. activities in the country. Right here is a big difference between the sister-university contracts with ICA, and those of American universities with U. S. government agencies for research and development in engineering science or technology, carried on in the university's own plant, many times without much of any liaison contact with outside agencies. The university research teams report the truths of Nature as they find them without detailed supervision or coordination by the U. S. government agency. But the execution of "sister-university" contracts may call for extensive "coordination." Few American university professors or administrators, accustomed as they are to wide freedom, enjoy seeing their university in the status of an employee of the Federal Government. This was one of the main complaints voiced at a conference on "University Contracts Abroad" held at Michigan State University last November, at which about 85 per cent of participating American Universities were represented. Representatives of the universities urged, and here I quote verbatim from their resolutions, "that the principle governing the relationship between the government and universities in this program must be one of cooperative partnership, rather than that of employer and employee."

The same conference indicated that there was need for a clear statement of government policy with regard to the continuance of these "no profit-no loss" contracts from the standpoint of planning for faculty personnel. When a sizable faculty team is sent abroad, their work at home has to be taken over by other competent people, since there is not at present and is not likely to be any decrease in the number of college students in the U. S. A. If a "sister-university" contract should be terminated suddenly, the American university involved might have faculty on the campus for whom there would be no salary budget. Gradual changes in staff can be taken care of, but sudden cuts would cause trouble. Representatives of the ICA at the November meeting pointed out that they cannot change the system of Congressional appropriations, and that Congress has long shown a disinclination to commit itself to promises of continued appropriations over a term of years.

The ICA has to keep its house in such good order that it can stand an

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ICA-WISCONSIN ENGINEERING EDUCATIONAL PROJECT IN INDIA

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Presented at the ECAC Conference of the Annual Meeting, June 27, 1956

During the spring of 1953 Dr. Raymond C. Gibson of the United States Office of Education came to seek the aid of the College of Engineering of the University of Wisconsin in administering a cooperative project to be sponsored by the Foreign Operation Administration. After devoting some time to the consideration of this project, it was finally decided to send Professors K. F. Wendt and H. A. Peterson to India for purposes of obtaining information about the desires of the representatives of our government in India and the attitudes of the Indian schools which were to be assigned to this project.

The Survey

The survey team left Madison on May 29, and returned on June 16, 1953. While in India, the two professors counselled with the representatives of the two governments concerned at New Delhi and visited five Indian colleges. These were the Indian Institute of Science at Bangalore, Bengal Engineering College at Howrah, also the College of Engineering and Technology at Jadavpur, both of these near Calcutta, the Indian School of Mines and Applied Geology at Dhanbad, and the Bihar Institute of Technology at Sindri. They then returned for a further conference with government officials at New Delhi.

During this survey the professors had opportunity to obtain information regarding the aid sought, living conditions, and the facilities available at the institutions visited. As a result of the survey, eight articles of agreement were drawn up and incorporated in a letter to Professor Humayun Kabir of the Ministry of Education and signed by Mr. C. H. Willson who was in charge of the United States TCA (now TCM) staff.

1. In accordance with the basic purpose of the agreement, freedom would be allowed the Indian Institute of Science at Bangalore and the Bengal Engineering College at Sibpur to work directly with the University of Wisconsin in arranging the details of the assistance to be furnished the former institutions on the basis of the general requirements now indicated with respect to all personnel, training, equipment, and supply questions.

2. The University of Wisconsin would also work directly with those institutions for which no sisterhood arrangements are contemplated at this time (Jadavpur, Sindri, Dhanbad, Pilani, Roorkee), but it would be the responsibility of those institutions to obtain such further clearances as nec-

essary from the appropriate Indian Government agencies, and to advise the University of Wisconsin accordingly. It was understood that the Government of India would advise those institutions of the procedures which would assure promptest possible handling of needed clearances.

3. The necessity for flexibility was recognized with respect to both the length and beginning date for the assignment of visiting professors. While every effort would be made by the University of Wisconsin to recruit for the periods originally requested and to have the visiting professors arrive as early as possible in the academic year, the minimum periods agreed upon and whatever beginning dates prove necessary will be acceptable to the assisted institutions.

4. The University of Wisconsin would keep the assisted institutions currently informed on the progress of recruitment, including estimated arrival dates, and on arrangements for such other assistance as might be involved.

5. Training facilities would be furnished for the primary purpose of providing faculty members of assisted institutions with the particular types of experience required, without regard to completion of degree requirements. Such faculty members would be selected by the assisted institutions in consultation with the visiting professors and the University of Wisconsin, with the idea of enabling the faculty member to replace the visiting professor upon completion of the training period. The University of Wisconsin, in consultation with the assisted institutions, would arrange for suitable training facilities in the United States. Individual training program objectives might dictate use of facilities, in whole or in part, at institutions other than the University of Wisconsin and in industry or elsewhere for in-service training.

6. Within the limits of available funds, it was intended that some minimum supplies and equipment immediately required in the work of the visiting professors would be provided by arrangement between TCA and the University of Wisconsin. Supply requirements of assisted institutions beyond this minimum would be reviewed in detail in consultation with the visiting professors and the University of Wisconsin for consideration of possible TCA aid.

7. Employees of the University of Wisconsin serving under its agreement with TCA would be accorded the same privileges as those accorded by Government of India to TCA employees in accordance with existing practice.

8. The funds required to pay the costs of the University of Wisconsin in furnishing faculty personnel, training facilities, etc., to the assisted institutions would be provided by TCA to the University from funds other than Fund A. To the extent that the individual requirements go beyond the initial TCA budget for the purpose, they will be met as the necessary additional appropriations become available.

Most helpful were the conclusions based upon this short but extremely strenuous survey trip. The following are the conclusions which provided answers to the critical questions raised before the trip was taken.

1. The Government of India and the individual Indian schools definitely want our assistance.

2. There is a tremendous oppor-

tunity to render service to the Indian schools in technical education.

3. In general, buildings and facilities at the Indian schools are adequate to permit good progress in implementing the proposed technical education program.

4. Special consideration must be given to the selection and recruitment of personnel for the various positions. Circumstances at several of the schools, Dhanbad and Sindri in particular, are such that families with children would find it difficult to secure even reasonable school facilities or adequate housing.

The following recommendations were made as a result of the agreements reached:

1. Agreement among all parties (TCA, the Government of India, the Indian schools, and the University of Wisconsin) should be reached on the eight points previously listed to insure a good prospect for success.

2. The University of Wisconsin would undertake to use its best efforts to furnish and recruit personnel for Indian schools in accordance with the stated needs, and supply or arrange for training of Indian staff members in reasonable numbers as later approved by TCA.

3. The contract should contain provisions for cost of travel in recruiting personnel.

4. The contract should be sufficiently flexible to permit time extension, if necessary, to cover the full period during which trainees might be in this country.

5. The program should be implemented as rapidly as possible consistent with securing fully qualified personnel who can be expected to fit harmoniously in the Indian school setting. It appears most important that a few persons be placed in the field very soon to show that progress is being made. The balance can be placed over a period of the next year or more as qualified personnel become available.

Contract

The initial contract with the Foreign Operation Administration involving the participation of seven Indian institutions was signed on June 30, 1953. The implementation of the agreement was set forth in a Work Plan which made provision for the recruitment of personnel, salaries, transportation, travel expenses, vacations, and housing allowances. The plan provides for the University authorities to be given liberal authority in recruitment of personnel, to arrange for interviews and to determine the qualifications of the personnel interviewed, travel expenses being chargeable to the contract. The personnel data on candidates nominated for positions are sent to the Indian school principal concerned, to the TCM office in New Delhi for information, and to the ICA office in Washington for security checking and for information. These data are also sent to the Indian Ministries of Finance and Education for their information. After approval from the Indian school principal concerned and receipt of clearance from Washington, formal letters of appointment to the candidate and a letter of acceptance from him provide the contractual relation between the candidate and the University.

Salaries are based on an equivalent annual salary using the conversion ratio which is applied by the candidate's American school. This usually ranges from 1.2 to 1.33. For this In-

dian assignment the annual rate is increased by 25%. Salaries are paid monthly by the University by check to the bank of the staff member's designation.

Transportation is purchased by the University through a local travel agency. The allowance is first class air fare for the staff member and his family to the post in India. Travel expenses necessary to the proper discharge of duties in India are allowed not to exceed $9 per diem plus transportation.

Each employee is entitled to one month's vacation per calendar year. If the employee elects to return from India by ship, the additional travel time over and above that required by air travel shall be charged against the earned vacation.

Each employee is supplied with an adequately furnished house or apartment. If such accommodation is not provided by the school in India, quarters may be rented at not to exceed $1600 per year for a family of two or more. Provision is made for equipping for modest living inadequately furnished quarters.

Household goods and automobiles may be shipped at contract expense providing that the cost of shipments in each direction shall not exceed $600 per adult, $200 per child, and shall not be more than $2000 per family.

With the exception of the maximum allotment of $500 per individual family per calendar year for medical expenses, which is chargeable to the contract, all other expenses are the responsibility of the employee.

Indian staff members who become participants in the program within the United States are approved jointly by the University of Wisconsin and the TCM administration in New Delhi. Participants are furnished first class air transportation to and from the United States and are given a per diem for their sustenance during the period they are within the continental limits of the United States. Initially this basic rate was $6 per diem; this amount has now been made $7 per diem at institutions where dormitories and cafeteria facilities are available and $8 per diem where living costs are higher. Provision is also made for travel status with reimbursements up to $12 per diem for those participants whose programs require absence from their base. Fees for enrollment in courses and tuition charges are chargeable to the contract. All trainees are required to purchase health insurance at the rate of $3.09 per month. Provision is made for mortician services in case of death of a participant.

The title for supplies and equipment purchased under the contract for use in the Indian schools is to be transferred to the school where these facilities are used. Items costing less than $500 may be purchased on approval of the coordinator of the project using the facilities of the Purchasing Department of the University. For items costing more than $500, approval of the director of TCM must be obtained before procurement can be made by the University.

Implementation of the Contract

In the present contract there are twenty posts, of which sixteen are primarily in the engineering field and four are not. One of the latter posts is that of adviser to the Indian Ministry of Education. These requests call for 44½ man years of service. The total number of requests for participants is now twenty-seven, of which twenty-one are in engineering and six

are in other branches of education. The Indian Institute of Science requested the largest number of participants, eleven, and Bengal Engineering College requested seven.

During 1953–54 the full efforts of the coordinator's office in Madison were expended in recruiting staff members for the posts in the contract. About July 1, 1954, nine professors, together with their families, numbering in all thirty-one persons, arrived in New Delhi. All of the professors in the group were placed on one-year contracts. Four have had their contracts renewed for a second year, and it is expected that one will be renewed for a third year. Thus far, twenty-three staff members have served on the contract. Of the latter number eight have, or are about to, remain longer than a year, but only four have remained or will remain two years or more. To date, 24½ man years have been or are being fulfilled and 20 man years are still needed.

Early in September, 1954, eight participants arrived from the Indian Institute of Science, and early in 1955 there came five participants from Bengal Engineering College and another participant from the Indian Institute of Science. To date, twenty-four participants have come from the schools joining in the contract.

Reflections on the Value of the Project

The contract provides some money for the purchase of equipment and supplies for the Indian institutions participating in the contract. The administration of this relatively small fund has been more time-consuming and bothersome than any other part of the project. This is due to the difficulty in obtaining prompt delivery of the facilities desired and the difficulties or expense attending shipment half-way around the world. Despite administrative difficulties, the fund appears to be essential to the success of the project. Especially valuable has this fund been in providing text books, slide rules, and other facilities which staff members have found to be greatly needed by students.

Upon arrival in India, professors have been requested to spend a period of orientation at New Delhi. It has been reported by those who have been through this experience that this orientation program could be best accomplished if the initial period were made three to seven days in length and an additional three-day period was given after the staff member had been at his post two or three months.

Although it is recognized that two-year appointments to the Indian posts are the most desirable from the standpoint of efficient operation of the project, yet the heavy demand for qualified staff members by institutions in the United States and the steadily increasing student load in our colleges have made it extremely difficult to provide appointments for more than one year. Some value of the services of professors previously appointed to Indian posts can be retained by making short-term appointments for summer service. These appointments can frequently be made up to four months in length. One such appointment is being made for the present summer at Bengal Engineering College. A report is made by each staff member at the end of each semester or term and a final report is made at the end of the contract. Some of the professors have sent most interesting mimeographed letters to many of their friends in the United States relating their experiences. As an indication of the ac-

tivity of the staff members who have served on the project it should be noted that they have 29 publications for their periods of service.

Most of these publications are short monographs dealing with technical subjects. In addition to these technical publications of a professional nature, most of the staff members have spoken at public gatherings, including scientific meetings, community programs, and meetings of Rotary Clubs. Many of our staff members expressed a strong conviction that one of the most important services they have performed has been in connection with their participation in local community affairs and their demonstration of the American way of life. Indeed, one of the professors in his final report ventured to say "I continue to believe that research is the least vital function that we TCM people here do. Teaching, illustrating the American system by precept and public and private example, and clarifying the attitudes of others toward the American way of life and American policy are our most important functions."

Most of the participants who have been sent to this country for further education either through course work, through participation in research, or through visitation of industrial plants have been relatively young men. As a group it is the opinion of the speaker that the persons chosen have been individuals possessing excellent qualifications both as to character and scholarship. However, it has seemed highly desirable that more opportunity should be given under the project for short visits of principals and other educational leaders in engineering in order that they might be in better position to assess the merits of the educational institutions in the United States and to estimate the value of training programs which might be provided for their staff members who would become participants. As a result two principals have been sent to this country for tours of approximately eight weeks each, and three more have been invited to come in the near future.

One of the major shortcomings in the educational possibilities offered participants is the lack of opportunity provided by industrial establishments in this country for in-service training of foreign nationals. Hence, most of the participants who have come to our program have been enrolled in educational programs leading to the master's degree. Three have been engaged in course work of a still more advanced type. Others have spent their visitation periods in traveling to institutions which have research or other educational work of an advanced nature in progress.

Judging from the reports which have been received concerning the aid furnished by staff members sent to India, their services have been greatly appreciated and in many cases they have been able to give real assistance in starting new educational procedures, particularly in the utilization of text books, the employment of quizzes, and more frequent examinations than has been common practice hitherto. At some of the institutions, new laboratory equipment and instructional procedures have been developed. At other institutions aid has been given in setting up and providing facilities for laboratories. At still others programs of research have been initiated or expanded.

The Indian participants in their final reports have uniformly expressed

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THE RUTGERS CONTRACT WITH THE ROYAL TECHNICAL COLLEGE OF EAST AFRICA

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Presented at the ECAC Conference on International Relations, June 27, 1956

In order to understand the nature of the contract between Rutgers University and the Royal Technical College of East Africa, one must know something about the people whom the African college is to serve.

As its name implies, the Royal Technical College will serve all of East Africa. This is a vast area of some 681,629 square miles straddling the equator and extending from the Indian Ocean to the Belgian Congo. The political subdivisions include Kenya Colony, the Kenya Protectorate, the protectorates of Uganda and Tanganyika, and the island of Zanzibar. Strictly speaking, the island of Zanzibar is not part of East Africa but is a separate state ruled by the Sultan of Zanzibar. However, its young people may attend the College.

This area is one of the last populated places on earth to be opened to travel and settlement by the white man. The whites first entered this region in the 1890's when the British decided to suppress the slave trade.

For many years the Arabs had been sailing down the east coast and had been raiding the native tribes to secure slaves. In order to put an end to this traffic in human misery, the British decided to construct a railroad along the slave route from the town of Mombassa on the coast to Kampala on the shore of Lake Victoria. They quickly found the native inhabitants to be too backward to assist in the construction of the line. Only 60 years ago these people had not yet discovered the wheel. They had no written alphabet, and had left no record of their history. In desperation, the British recruited thousands of workers from India. Thus the railroad started forward with British engineers and Indian workers.

Construction of the road was beset by many difficulties. Tropical diseases and wild animals took their toll. The long supply line to England frequently broke down and left the workers stranded without materials. During one of these delays the men erected a cluster of shacks for protection against the animals and the elements. As the delay continued, the cluster of shacks grew. When construction finally was resumed, the shacks were left as a way-station on the line. The cluster of shacks, started by accident, has now become the thriving capital city of Nairobi, the largest city in East Africa at which is located the Royal Technical College.

As often happens in cases of this sort, the people who came to build the railroad fell in love with the country and remained there. Thus the population is now a mixture of some

19 million native Africans, 299,100 Asians, and 69,100 whites, mostly British.

The division of labor today is much as it was when the whites first began the railroad. The British are the engineers and governmental leaders. The Indians dominate all of the trades, and the Africans struggle along at the bottom of the economic scale. Apparently it is the Indian who stands most in the way of advancement for the African. With all of the crafts and trades dominated by the Indian, the African finds it difficult to obtain other than menial jobs. India appears to be making a strong move to colonize and dominate the area. Indeed, there are some people who believe that India may some day control all of Africa.

Recognizing a humanitarian responsibility to help the native, the British set up a school system soon after entering the country. This system culminated in the establishing of a full-fledged college more than 20 years ago. This is Makerere College located near Kampala, Uganda, and since 1950 affiliated with the University of London. The curricula feature liberal arts with some instruction in medicine, veterinary science, education, and agriculture. Important as these subjects are, they do not meet the basic needs of this virgin territory. People began to recognize a pressing need for trade schools to teach the Africans to become carpenters, bricklayers, mechanics, and electricians. Such schools were established. Then it became apparent that there was need for college-level instruction in such useful fields as architecture, commerce, science, and engineering. Thus, around 1950, it was decided to establish at Nairobi a college composed of the faculties of architecture, arts, commerce, science, domestic science, and engineering.

After a preliminary survey by an expert from England, the Public Works Department of Kenya was instructed to build a college. The cornerstone was laid on April 25, 1952. In the summer of 1954 the Royal Technical College consisted of buildings under construction and a three-man staff, the principal, the bursar, and the head of the science department. It was at this point that Rutgers entered the picture.

In response to a call for aid, the Foreign Operations Administration (now called the International Cooperation Administration) asked me to visit Nairobi to determine how the Rutgers College of Engineering might assist in developing the engineering faculty of the new college. Our assistant dean, Maurice T. Ayers, and I went to Africa in October, 1954, to study the situation.

Our first action was intended to obtain the necessary background information to determine the number and type of the engineers needed for the economy of East Africa and the number of qualified students who might be available annually from the secondary school systems. We quickly discovered that such information was not readily available.

After much cooperative effort among the small but very capable staff of the college, the East African Association of Engineers, the local school officials, and the U. S. Information Service, it was finally agreed to plan for curricula in Civil, Electrical, and Mechanical Engineering, with an entering class of 60 students. It was evident at this point that the most immediate need of the Royal Technical

College was for advice regarding the planning of the curricula, the selection of books, and the selection of suitable laboratory equipment. It was also evident that Professor Ayers and I could not possibly carry out the work in all of its details by ourselves. We, therefore, decided to estimate the magnitude of the necessary aid with the understanding that the entire engineering faculty at Rutgers would later provide the detailed services.

It was plain from the start that a British staff would operate the College and that the British type of curriculum would probably be used. Nevertheless, the Principal was most anxious to take advantage of the best features of the American system. Hence we were requested to provide curriculum plans and detailed course outlines in the American pattern.

After outlining the three curricula in rough form, Professor Ayers and I made a tentative list of the equipment which would be needed for the related laboratories. We observed at once that the original space allotted to the engineering faculty would be far too small to house the needed apparatus. Thus our next task was to make a tentative floor area plan for an additional laboratory building. We estimated that the needed equipment and building would cost approximately $390,000. At this point we returned to the United States.

Our report to the Foreign Operations Administration recommended that a contract be drawn with the Royal Technical College permitting Rutgers to provide curriculum plans, course outlines, sample examinations, copies of recommended books, and advice with regard to building plans and equipment. It was also recommended that FOA provide the funds for the necessary laboratory building.

After the usual delay, a contract was prepared. Subsequently, we sent to Africa a basic engineering library, very detailed outlines for all of the courses in the three curricula, and a comprehensive list of laboratory equipment.

It is interesting to note that the native of East Africa is skipping thousands of years of the slow evolutionary process which has brought the white man to his mechanized civilization. In the lifetime of one man the natives of this area have moved from a people with no alphabet to a people who are already operating gas turbines. The African needs the most modern engineering education because only the most modern engineering devices will be used in his country. Our suggestions took this fact into account.

The staff of the Royal Technical College, now considerably expanded, is working on plans for the new laboratory building. An excellent and most imaginative architectural design has been prepared. We have submitted our criticisms of the original design and are now awaiting what we hope will be the final revision. It is our expectation that an American Wing will soon be under construction.

In the meantime, the College has completed its basic classroom and laboratory units as well as some dormitories. It opened its doors to the first class on April 23, 1956. The first students will pursue an introductory program which will end on July 14. Hereafter, the regular college year will run from October to July.

In the beginning, the engineering programs in civil, electrical, and me-

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SCIENTIFIC AND TECHNICAL INSTITUTIONS IN UNDERDEVELOPED COUNTRIES

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A paper presented at the ECAC Conference on International Relations, June 27, 1956

In ancient, classical times, as you know, the Greeks lived in city states. Aristotle once remarked that a city should be no larger than one across which the voice of the town crier could be heard.

Today, through science and engineering, the world has become a city, and the voice of the town crier can be heard across it.

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I am delighted and grateful to have this opportunity to speak this morning on the implications of President Eisenhower's Baylor address in which he proposed to the universities and foundations of the country an educational "Point 4" program of scientific and technical institutions for the underdeveloped regions of the world.

I must warn you at the outset that I am a propagandist—not in the narrow sense, for Robert College and Turkey, which I shall use as examples, but for what can be accomplished in the free world (and by example in the unfree world) by the President's program; and for what has been accomplished already on a limited scale through liberal-professional education by the American sponsored education in these areas. No one who has seen at first hand its contribution to democracy, to the scientific and progressive attitude of mind and to human welfare can fail to be a propagandist—unblushingly and unapologetically for what is being done.

The key to President Eisenhower's Baylor proposal lies in his statement, "The whole free world would be stronger if there existed adequate institutions of modern techniques and sciences in areas of the world where the hunger for knowledge and the ability to use knowledge are unsatisfied because educational facilities are not equal to the need."

And he adds: "I firmly believe that if some or all of our great universities, strongly supported by private foundations . . . would devote themselves to this task, the prospects for a peaceful and prosperous world would be mightily enhanced."

Naturally, the imagination leaps at such a proposal. To educators, who believe that the key to progress is trained intelligence, there is opened a vista as grand as that of the Marshall Plan and even more compelling, because it is directed at the creative possibility of education.

Almost everyone will agree in principle that this is a splendid idea, but, together with the enthusiasm it may generate, there will also be practical skepticism and dismay.

On a limited scale, Foundations are already engaged in overseas programs and they have important domestic commitments as well. As William Benton has pointed out—"If all of the

uncommitted 1957 income of all of the major American foundations were to be devoted to President Eisenhower's suggestion, the total would not remotely meet or match the need or the challenge implicit in it."

For their part the universities, who would be expected to supply the personnel, find their resources even less up to the task proposed. Faced with increasing competition from industry, the rise in college enrollment and the demands on all sides for more engineers, they are hard-pressed now and will be harder pressed soon simply to cultivate their own gardens. "Can we take on the whole world?" they ask.

* * *

I think we must recognize that short of a great government-financed program we could not create an educational Marshall Plan commensurate with the challenge implied, and even then the shortage of trained personnel would be a controlling factor. But this does not mean that nothing can or should be done. Quite the contrary—and I want this morning to suggest something of the experience of one institution working in this field as an example of the possibilities in the President's proposal.

I should like to tell briefly about a man named Vecdi Dikerj who is today a consulting engineer in Ankara. In 1932, he graduated from Robert College and came to the University of Missouri to take his master's degree.

Neither at Robert nor Missouri was he a brilliant student, but he got by, and at the same time he absorbed some things from the general atmosphere of these two institutions, among which were the conviction that his country's future must be based on education, a strong bias for education in the English language (because it opens so many possibilities) and a belief that the way to get things done is to do them.

Dikerj is a patriot, a dreamer, and also a doer. He embodies the determined spirit of national independence and revival which is so evident in many areas of the world and which often for lack of creative channels through which to work expresses itself destructively.

He embodies the tradition of Kemal Ataturk which in 30 years has brought Turkey from a backward and moribund Empire to a progressive and developing young republic.

When Dikerj returned to Turkey, he went to work for the department of highways and in a few years was Director General of the Highways. But in those days and immediately after the war, Turkey had few highways. 80% of the Turkish people were peasants living in villages completely cut off from the main centers of life and the westernizing influence.

In 1946, Russia made demands upon Turkey for a revision of the Eastern frontier—the opening wedge in a move toward control of the vital Straits. The Turks refused flatly to discuss this question and prepared if necessary to defend their frontiers alone and to the last Turk. The United States came to the support of Turkey and under the Truman doctrine began a program of military assistance.

But there were no highways between Ankara and the Eastern frontier over which men and supplies could move. Dikerj accepted the challenge and in nine months, with some help from American engineers, an all weather road was built 350 miles across the mountains from Ankara to Erzerum on the frontier. After some

time in the face of Turkish determination and American support, the threat of aggression passed.

But Dikerj and another Robert College graduate, Kasim Gulek, then Minister of Public Works (about whom you can read in the June 20 *Time* magazine) were not content merely to build military roads on an emergency basis. All Turkey needed roads for its economic and social development and Gulek proposed to the Council of Ministers a vast program.

The program was approved, but when it came to how it should be done, Gulek struck a snag. The ministers wanted roads but were reluctant to accept outside technical assistance, fearing that it would lead to political domination. Dikerj and Gulek knew that good basic roads could be built only on U. S. specifications and with American technical aid. They knew also from their experience in an American college that American assistance and friendship could be sincere and without ulterior motives—genuinely devoted to the welfare of Turkey.

To carry their point, Gulek did what is rarely done in Turkey—he assumed personal responsibility as Minister for the decision to build the roads with American assistance.

Today—eight years later—Turkey has a great new network of all-weather roads reaching the great majority of towns and villages. The effect upon the country's economic and social progress is incalculable. The peasant is no longer bound to the village and its centuries-old routine. He now moves into the world. And into the village is coming the teacher, the doctor, the radio, and the newspaper, and with them, the realization born out by western experience that now he can bend nature to his service.

One further point of illustration—a small one, but significant. One day, I visited with Dikerj a maintenance center for highway equipment—directed, incidentally by another young Robert College graduate. There, laid out in perfect order, were the paint shop, the electrical shop, the body shop, the motor repair and so forth. Each item of equipment was being periodically checked or maintained.

The point is clear. You can send money and equipment and neglect the personnel and the result in the long run will be wasted money and rusted equipment. But the mind and zeal of an educated man does not rust; given education and friendly advice in the beginning, he can and will do the job himself. Through education we can transmit, not the products of our own creative enterprise, but some of the creativity itself.

This is the greatest and at the same time the cheapest investment we can make in our own security and welfare with that of other peoples of the world.

The example of Dikerj and the highways is repeated throughout Turkey many times. Recently in an article in *Life* magazine, Clarence Randall, the President's special adviser, wrote after a visit to Turkey:

"The impact of American education is already great. Everywhere in Turkish government or business offices one encounters men trained at century-old Robert College or some of the other schools established by American philanthropy. Americans could have done nothing more enlightened or better calculated to serve the cause of ultimate peace than the establishment of those schools."

My example has been Turkey, but

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SUGGESTIONS FOR GRADUATE STUDY IN OPERATIONS RESEARCH AND SYSTEMS ENGINEERING

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A paper presented at the ECRC joint conference with Graduate Studies Division, June 28, 1956. The views are the writer's and do not necessarily reflect those of the General Electric Company nor any of its officers, executives, or managers

In industry and in the military, enthusiasm is growing for what is termed here "Operations Research" and its closely related subject "Systems Engineering." It is timely, therefore, that the ASEE should examine how to educate persons for this new profession. I am happy to offer my views as part of this examination process. Frankly, I am an enthusiast for the opportunities here. I hope that I shall be able to infect you, too, with a belief in these opportunities.

In order to provide the background and orientation for my remarks, I will retrace briefly some of the recent developments of OR. (I will not duplicate the extensive literature on its history and genesis which in a real sense can be traced to the Egyptian Geometers and Euclid.) I will endeavor to extract certain concepts from two recent, simplified examples and, then, trace the path by which these concepts have evolved into the current and possible future practices and attitudes in this field. This will permit me, then, to make some suggestions on graduate training for OR, at least for business and industry.

Two World War II applications of Operations Research, though greatly simplified, illustrate my initial concepts. The first was a problem brought to the attention of the operational commanders of the Pacific Fleet as follows.[1] Surface radars had been installed on our submarines, thus increasing their effective horizon, say, from a radius of ten miles to fifty miles. When the submarines began to use the radar equipment, the number of contacts with enemy aircraft increased frighteningly. The submarine commanders' immediate reaction to the increase was that the Japanese aircraft carried equipment to detect search radar signals; with such equipment they could discover the submarines and "home in" on their radar signals. The immediate impulse, therefore, was to discontinue using or to remove the radar equipment from the submarines. The Fleet Commanders asked the Operations Researchers to make a study of the situation and submit their findings.

The operations researchers "theorized" that the number of aircraft sighted should be roughly proportional to the area swept by the search device, whether visual or radar, and that the area of the circle swept at any point is proportional to the square of the radius of the search horizon.

[1] For a complete technical treatment of searching, see B. O. Koopman, *Journal of Operations Research*, "Theory of Search," June 1956, Vol. 4, No. 3.

It should be expected that, with a radius five times as great, the number of contacts should be approximately 25 times as great. ("Approximately" is used here for simplicity because there is an uncertainty involved in sighting an aircraft, either visually or by radar, which varies as the distance from the observer.) By analyzing the results of actual sightings with visual and radar devices with reference to this "model" or "theory of radar search," the operations researchers inferred that the Japanese planes did not have, or were not using, radar detection and homing devices. Hence, the radar was serving its purpose without adverse effect and the submarines should continue to use the radar search equipment. Post-war investigations proved the operations researchers right in their inference.

In the European theatre a different type of problem was encountered. The Commander of the U. S. Air Force noted that, as the number of planes in a bombing raid increased, the number of planes lost in that raid also increased. The question was, should the size of the bomber fleet be smaller or larger in order to minimize losses for a given quantity of bombs dropped and bomb effectiveness? The initial belief was that the size of the bomber fleet should be made smaller instead of larger. The operations researchers studied the situation and theorized that the number of planes lost did increase as the bomber fleet size was increased, but that it was a less than proportional increase. An analysis of the inter-action of the enemy anti-aircraft with the attacking bombers was made. It indicated that, with a fixed enemy fire power, the total number of hits should not increase in proportion to the number of bombers in the fleet. Thus, the conclusion was that the larger the bomber fleet, the smaller the expected percentage of planes to be lost and that the large fleet size should be used. As you recall from the headlines, this policy was adopted by the air commanders.

The majority of operations researchers who made these types of studies were scientists, usually trained in some discipline characterized by scientific objectivity and rigor, such as physics, biology, or logic. In studying these new situations, these scientists recognized that an important part of their work was doing "research" to discover the relationships between the elements or objects of the operation or system under study. Hence, these scientists termed their work "Operations Research." However, if you examine it more closely now, you can see that, indeed, they did do research to discover principles, relationships, etc. governing a system or circumstance.

But they went beyond discovering principles or underlying theory; they also "designed" a system or elements of a system so that the system as a whole would behave in some manner which they (on their side) considered best. The importance of this "design" aspect of their work should not be under-emphasized or under-appreciated. Of course, they based their design upon an explicit, rational theory of the case which was complete with assumptions which they could test and with conclusions deductively obtained. The symbolic portion of the theory they termed a "mathematical model," although engineers and physicists more often use the term "ideal system."

After the war, the operations researchers asserted that their methods

–and they emphasized their "methods" of research–were equally applicable to improving industrial operations. Thus, much of the early postwar work in industrial operations research was "methods focused." In any case, they made many useful contributions. In response to these contributions and to the apparent successes Operations Research achieved during the war, certain persons in General Electric decided that OR should be studied carefully to determine whether or not the claims made by the operations researchers were valid and, if so, how best this collection of techniques or concepts could be used within the Company. The essential findings of the study group were that, as a collection of tools, Operations Research offered a small but important refinement in methods of solving problems which often were resolved already by experience and intuition. This was the view also of others, including Levinson [2] and myself.[3] However, quite above and beyond the concept of Operations Research as a collection of methods, the study group recognized much greater potentialities of the broader research and design concepts as the basis for a particular kind of work with a definable and identifiable contribution to a business. At the risk of over-simplifying, it might be said that the essential findings of the study group were that a business enterprise as an operation or a collection of operations is amenable to rational idealization, analysis, and design, just as a product, for example, is amenable to rational idealization, analysis, and design. The important discovery of the wartime operations researchers was not that operations could be researched by scientific methods, but that they could be idealized and designed by conscious, rational processes, including scientific methods.

From this discovery arose the important concept of the "design of an enterprise" as the central contribution of OR. The special format through which the design is expressed is mentioned later. However, the design task is very challenging and it is not at all obvious as to how it can be performed rationally. I will consider this point in more detail later. Of immediate interest is that the concept leads to the usefulness of a special component of the business enterprise to design the enterprise, just as a component is needed to design the product. It has been found that this component is most effective if it is concerned with the design of the enterprise in the broad, in identically the same sense that the systems engineer in "product design" is responsible for the design of the system in the broad, and not the design of the components of the systems in detail. This concept and need has been studied carefully and its implications recognized also by the managers of some of the Departments of the General Electric Company (each department is a highly autonomous enterprise).

Thus, a significant number of departments of the General Electric Company have adopted such organizational components and, now, are doing work of this type under the name "Operations Research and Synthesis." Other companies are endeavoring to do similar work under various names.

[2] "Operations Research in Business," *Fortune*, February 1956.

[3] Salveson, M. E., "Theory of Production," *Journal of Industrial Engineering*, 1953 and "New Look in Industrial Engineering," 1955.

In order to assure that the context within which the "design of enterprise" process is performed is understood, certain elements and relations within the process are explained. Firstly, the responsibility for design never rests solely with the designer. This corresponds to Clemenceau's admonition that "War is too important to be left to the Generals." Similarly, design of product or enterprise is too important for the designer alone.

The essential point is that a set of design criteria always must be consistent with a higher set of criteria —which are often difficult to quantify or verbalize. This leads to the second aspect: the relation of the designer to the enterprise manager. The designer—as the sense is intended here —conjures representative, alternative, preliminary designs for the product or enterprise, according to the principles, laws, and criteria which govern the object designed. These preliminary designs usually are evolved and tested via the medium of "ideal systems" or "mathematical models." In essence, they make it possible to eliminate unfeasible or uneconomic alternatives early and to permit selection of the feasible by higher echelons.

The process holds both for product and enterprise designers. This leads to the third concept that concretion of a design is, or should be, accomplished after it has been established that the design satisfies the higher criteria mentioned. In this context, therefore, the designer of enterprise provides the technical proficiencies necessary to achieve the structure, purpose, etc. of enterprise which are established by higher echelons and criteria. He does not provide these criteria nor does he have sole responsibility for creative innovations in any or all aspects.

Educational Effects

I expect that the impact on education of this innovation in enterprise design will be a mushrooming demand for manpower especially trained for this work. The university, of course, will be called upon to supply the demand. Indeed, this demand already is being expressed now in the increasingly large number of requests for graduates who combine training in the sciences and scientific methods, in the institutions and concepts of business, and in the application of these methods to those institutions.

Some of the leading colleges in the field are the School of Industrial Administration at Carnegie Institute of Technology; the Department of Engineering (Engineering Executive Program) Univ. of Calif., Los Angeles; the Department of Management Science at Case Institute of Technology; the Department of Industrial Engineering at the University of Michigan; Department of Industrial Engineering, Columbia University; Operations Research-Systems Engineering Program in the Moore School of Electrical Engineering at the University of Pennsylvania, and several others.

As a supporting move, in the American Society of Mechanical Engineers we have formed a special committee on "Operations Engineering" to pursue this same subject. The term "Operational Engineering" was selected as its name because, properly conceived, "engineering" embraces the full spectrum of intellectual activities: creativity, research, development, design, synthesis, and application. Of course, no single engineer usually

performs all these activities, but they are part of the total process. Thus, "Operations Research" as a term was considered deceptively restrictive of the Committee's intended sphere of interest and activity.

The point I have stressed thus far is that the process of "Operations Research" or "operational engineering" is very similar to traditional engineering design work. Thus, our syllogism requires that we briefly review now the process of product design engineering. It involves, of course, conceiving the idea of a product, doing research—if necessary—to discover the principles or to discover what existing principles govern the operation of the product, as for example: field theory, conservation of energy, conservation of mass, laws of motion, or other. The particular intellectual processes are:

A. The conception of the idea for the product. The possibility that the product or object would be useful in affairs of the world must be brought to the conscious mind by some creative individual before it can be designed and constructed. The ability to conceive the idea for a new or modified product requires good understanding of the technical sciences which underlie its operation, the feasibility of producing and designing the product, as well as its relative usefulness to society or its members. This, of course, is not the exclusive responsibility of the designer.

B. The theory of the product or system so conceived. While he may not recognize it consciously, every engineer in designing a product or object develops a theory of that product. Without such theory he has no basis for reasoning about the object. This theory includes, as any other theory includes, a set of undefined terms, axioms, and specific theorems on the phenomena which underlie the operation of the product or system.

In product engineering, the usual undefined terms include a mass, energy, temperature, force, etc. The axioms are the known physical and chemical principles, as well as the existence of a need for a product and of the processes and resources to produce it. The theorems are statements summarizing the reasoning on how a product or system would operate or behave. These are the "mathematical models" or "ideal systems" used to approximate a given product or system. It is used to select, usually at higher levels, particular alternative systems for concrete design.

C. The design of the product is based upon the theories and is a concretion of those theories into a specific configuration and structure. The design specifies the components of the product, the inter-action of the components, the materials and properties of the components. The design usually is portrayed in some manner appropriate to the needs, such as drawings, specifications, processing instructions or other guides.

Later steps in the total process would include: construction of the product, operating or using the product and obtaining "feedback" on the operation of the product so that the basic axioms, theorems or design can be corrected and the resultant design perfected ever further.

In the usual design engineering the knowledge and skills principally required in developing a product are in physics, chemistry, engineering mathematics, engineering drafting, language and, recently, but still in a

relatively minor way, kinesthetics, human engineering, the economics of the product. Thus, most engineering curricula now emphasize the subjects which underlie "the operation and design of products." This emphasis is necessary and highly desirable, of course, for those engineers who will confine their careers primarily to product engineering.

If the proposition that an enterprise or operation also can be rationally and consciously designed is true, then the process of enterprise or operations design can be shown to be consistent with the preceding process for engineering a product. On inspection, it is clear that the conception and design of an enterprise does follow the preceding process, although at present it often may be largely intuitive, just as 18th and 19th century product engineering was largely intuitive. However, OR has demonstrated that it is possible now to reduce the amount of purely intuitive design and analysis and to increase the level of rigor of this work so that it is comparable with the level of scientific rigor in the more developed fields of engineering. The simplified World War II examples illustrate the conception-theory-design sequence in operational engineering.

Although the process applied to an enterprise is essentially the same as applied to a product, the enterprise to produce a good or service is at least as complex as the good or service which it is to produce. Actually, of course, it is usually vastly more complex and intricate. Thus, the difficulty of designing the enterprise is at least as great as designing the product. For example, a business enterprise can be viewed as any and, simultaneously, as all of the following:

A. A set of physical facilities.
B. A financial investment and series of calculated risks.
C. A network and system of cash and value flows.
D. A network and system of material flows and material transformations.
E. A collection and structure of individuals, each with certain attitudes and abilities.
F. A decision and communication network and system.
G. A device for making decisions on use and allocation of scarce resources, i.e., on rationing and economizing.
H. An instrument for satisfying human material needs.
I. An instrument for satisfying human social needs.
J. The locus at which we individually and collectively practice our ethics, morals, and religion.
K. An opportunity for psychological release of our aggressive propensities.

A business enterprise is each of these and it is all of these simultaneously and more; hence, the design of any enterprise must account for all of them simultaneously. In designing the enterprise, it is necessary to consider each aspect of the design from each of these perspectives and to assure that the concretion of the theory of the enterprise into the design is at least consistent with the needs and requirements in each of the other aspects. Thus, if an enterprise is designed with the care and precision with which a product is designed, the task is usually far more difficult.

Of course, no single scientist, engineer, or analyst alone could design an enterprise of any significant scale and

scope. Rather, a group of persons with appropriate skills is necessary for this purpose. However, all persons participating in the analysis and design of an enterprise should have the breadth of perspective to envision whether any design decision in one area would have an impact in any of the many other aspects of the business. As can be gleaned from the list above, these aspects of an enterprise involve such diverse sciences and disciplines as economics, psychology and group processes, communication theory, decision theory, computers and electronics.

Thus, Operations Research and Systems Engineering, as applied to business enterprises, require a wholly new level and breadth of training and understanding for adequate application and professional practice. They require an ability to discern and test relations and inter-actions in individual-machine-social or even economic systems, the ability to construct idealized models and/or theories of such systems for testing and selecting alternative designs and configurations, ability to reduce alternative to specific designs, and to translate those designs into the appropriate information symbols for communication. The product engineer's communication techniques are primarily the engineering drawings and instructions with or without material and process specifications.

Media for communicating and translating enterprise design include those of product engineering plus, at least, the following: verbalized policy and attitudinal statements, verbalized and graphic plans, organization hierarchical charts and networks with particular reference to information—decision networks and structures and to communication and information networks, decision criteria and rules, planning criteria, methods and rules, operating characteristics of facilities, operating methods and procedures. Obviously, therefore, the task of designing an enterprise and translating that design into these appropriate information symbols is a complex task and is as challenging as the design of any physical product or system, especially if it is designed with rigorous scientific methods, rather than by unaided intuition.

The purpose in the many different instruments or vehicles for displaying the design and structure of an enterprise or an operation is to convey its many, indeed, its very large number of, equally valid alternative descriptions or points of view. For example, a human correctly can be described for various purposes as a massive object, an exothermic object, an energy source, a set of beliefs and attitudes, a gambler or risk-taker, a temperature-sensitive object, an information-processing device, a set of rights and obligations.

There hardly can be a single common description or vision of even a simple product; a complex enterprise or operation is even more difficult to describe completely in all its relevant essentials. Indeed, not all participants in an enterprise would want or be able to use or to understand such common description if available.

Thus, there is the need to derive a series of special, partial descriptions of the enterprise or operation, each using appropriate vehicles of display and each for a particular member or set of members. These descriptions each should be such that: (1) the description permits the member for whom prepared to behave or to be designed so that the whole behaves

as is desired and (2) so that the behavior or design of any member is consistent and compatible with the other members. This is part of the work of the systems engineer, operational engineer, or enterprise engineer, each in his respective field. In particular, it is mapping the design or behavior of members on to design or behavior of other members and/or of the whole, and vice versa.

The following is a brief description of one instance in which these concepts were used in achieving a new design of a business enterprise. The enterprise in this instance is engaged in the design, manufacture and marketing of a large and complex product. The initial study was undertaken in order to improve one operation in that enterprise; that is, the product engineers were planning to use new methods and facility for certain design engineering computations.

Before they could use their new methods and facility with greatest advantage, it became clear that they should consider the possibility of changing the product from a custom-engineering product to one which would be engineered from standard components and with a standard or generic shape and configuration. The economic feasibility of the new facility depended upon the technical and economic feasibility of the change in the basic concepts and method of designing the product.

Upon analysis, it was found that a change in product design concepts, in turn, depended upon the technical and economic feasibility of many other changes, such as, the marketability of the redesigned product, its relative operational efficiency in the customer's system, the methods and economy of its manufacture, the methods of drafting its plans, the pricing and competitive policies which the redesigned products would allow or require, the advertising and sales promotion theme for the redesigned product, the changes in the basic manufacturing theory to adjust to anticipated changes in character of demand, etc. In addition, it was necessary to redesign methods and procedures affecting personnel so as to adapt to the human and social needs in the new environment with its implied changes.

Before the change in method of design computation could be made, it was necessary to interpret it and its derivative changes or implications in virtually all other operations of the enterprise so that the enterprise as a whole could be redesigned and restructed to accommodate the new operating characteristics of that one element of the enterprise. The redesign of the enterprise required a coordinated and integrated study of the business as a whole and of its components, such as marketing, manufacturing, engineering, advertising and personnel policies and procedures.

For effective redesign, the study group needed the ability to manipulate diverse concepts or principles, such as, in electrical engineering, mechanical engineering, systems engineering, manufacturing engineering, market analysis, economic analysis, game theory or competitive strategy, communication and information theory, psychology and group dynamics. The output from their studies is a new design and structure of that enterprise—a new way of doing business.

Over-all design, in turn, is translated into the brick and mortar and the detailed design for all components of the enterprise by the members of

those components, and in such manner that the design of each component is reliably consistent with the objectives and concepts of the whole.

The changes initially induced by the introduction of the new computation method resulted essentially in a wholly new design of enterprise and method of operation. Of course, not all redesigns are as dramatic. In most instances, the redesign to be effective must be continuous, just as the redesign of a product must be continuous if that product is to remain competitive. The need for evolutionary redesign of the whole enterprise may arise from any significant change in any of the components of the enterprise, in its product, in its technology, in its social or political environment, or other. The fruits of any innovation can be brought to society only when the system or enterprise has been designed to accommodate and to achieve that innovation. Hence, evolutionary design of the enterprise for innovation and change is designing for progress.

Although this is written primarily for engineering educators, it is to be noted that the operations researcher, enterprise engineer, or whatever he may be termed, is not the entrepreneur or entrepreneur-manager. He is a delegant of and, hence, responsible to the entrepreneur, just as other delegants also are responsible to entrepreneurs for the performance of their respective delegated function.

The educational question in regard to the enterprise analysis and design function discussed herein is not whether it is to be performed at all but whether it is to be performed ably and by persons especially trained for it. Already a special course has been established in the General Electric Company's Operations Research and Synthesis Consulting Service for training persons entering this kind of work.

Of course, once university-level Schools of Engineering and of Business Administration begin to offer integrated curricula in this new function, this special course may well be discontinued. It is noted that this course does not emphasize the techniques—linear programming, queueing theory, etc., which already are widely available—but, rather, the analysis and design function for which these techniques are but important tools.

I am quite confident that special training can and will be provided in the near future by university-level graduate schools of engineering and, possibly, of business administration through their curricula in the Management Sciences. My suggestions as to graduate study in preparation for this field are as follows:

Firstly, as S. F. Teele, Dean of the Graduate School of Business Administration, Harvard University once said: "There are some tricks you can teach *only* to *old* dogs." The problem of enterprise analysis and design is, indeed, one which can be taught best to "old dogs," or those who personally have experienced the multiplicity of the conflicting demands and interests which converge on the managers and designers of enterprises and who, therefore, already realize the existence, difficulty and urgency of reconciling the demands in the design of the enterprise or its operations.

Graduate study in this field should be primarily for those who have at least some minimum amount of experience in business or industry and who are both intellectually and emotionally ready for such training. There is, of course, an opportunity to develop and offer undergraduate cur-

ricula for "young dogs" who may wish to enter this profession. That presents, however, a separate design problem and is not considered here.

Secondly, as to subject matter, I would hesitate to outline specific courses and numbers of study hours which would be desirable. Rather, I would suggest areas in which understanding and competence beyond those ordinarily provided by the more traditional engineering curriculum ought to be available. These lie, I believe, in five categories. They are not necessarily mutually exclusive nor complete. But they are suggestive.

A. Relevant sciences or bodies of knowledge on the phenomena of the real world. These would include:
   1. Physics
   2. Chemistry
   3. Psychology, Group Processes and Human Motivations
   4. Economics and Economic Geography
   5. Language, Thought and Communication

B. Relevant institutions or socially and individually imposed boundary conditions.
   1. Government and Political Institutions
   2. Social Control of Economic Activities
   3. History, including of science
   4. Citizenship and Responsibilities of Political and Economic Liberties
   5. Ethics and Philosophy, including of science
   6. Business and Economic Institutions and Practices

C. Relevant tools of formal analysis or symbolic systems for use in manipulating ideal systems.
   1. Usual Engineering Mathematics
   2. Logic and Boolean Algebra
   3. Linear Algebra and Matrix Theory
   4. Probability and Statistics
   5. Game Theory
   6. Calculus of Variations
   7. Measure Theory
   8. La Place Transform and Operational Calculus

D. Relevant constructs or the materials, process and systems of analysis as applied to specific phenomena.
   1. Usual Engineering Course plus:
   2. Information and Communication Theory, especially as related to Man-Man and Man-Machine Communication Systems
   3. Economic Analysis (Qualitative and Quantitative) essentially as Business Ecology
   4. Systems Theory and Network Analysis
   5. Information Processing Equipment

E. Phenomena of enterprise or the phenomena characteristic primarily of organized human endeavor.
   1. Individual and Group Decision Processes and Group Structuring
   2. Organization Theory in Individual, Social, Man-Machine and Group-Machine Systems
   3. Decision Theory and Competitive Analysis
   4. Creativity and Idea Propagation
   5. Individual and Group Motivations
   6. Ethics, Value Theory, and Choice
   7. Program Planning and Testing

The above constitute, according to my experience both in industry and

academia, the intellectual equipage for professional work in this field. It is, however, only the point of departure and not the goal. Finally, and importantly, the student should be given concrete experience and competence in the application of these basic sciences to the design and structuring of operations and/or enterprises. I believe this is done best through vicarious and/or direct experience in these functions. Such experience may be gained through appropriate case problems, externships or on-the-job supervised problem-solving.

In all these the student should be required to "solve" or design an enterprise or operation thereof whose complexity and scope are sufficient to challenge his abilities. His studies and experiences in these should be made meaningful by careful instruction and supervision, by a staff of instructors operating as a well coordinated team with each member thereof providing the competences or insight in one or more of the various disciplines which are necessary to solve such problems. The instructional team to administer the studies and the use of general principles to resolve such problems appear to be a significant departure from the present case method of studying and training in problems of design and operation. That is, each sample case, as suggested here, would not be an ad hoc collection of circumstances for which no general principles or tools of analysis would be demonstrated for solving the problem in a definitive kind of way. Rather, it would represent a unique, but illustrative, collection of circumstances to which general principles and methods could be applied, leading to the rational design of an enterprise or operation, thereof, in the same manner that "hardware" engineering problems can be "solved" to lead, usually, to a design of a product or system for specified purposes.

I wish to make particular note that the concepts and principles implied above, in humanities, e.g., ethics and philosophy or citizenship and responsibilities of political and economic liberties, are as much a part of the intellectual paraphernalia and design criteria the enterprise or operational engineer uses as is, say, integral calculus or thermodynamics. This, I believe, is a view different from that expressed in the recent ASEE report on General Education in Engineering [4] wherein humanities are conceived as providing essentially an extra-professional cultural background for the engineer. My point is that the enterprise engineer uses, or is guided by, all of the concepts in the above list as may be appropriate to the specific task at hand; in many design tasks good citizenship, psychology, or ethics is more important than good calculus in achieving the optimum-solution or design.

The preceding recommendations are intended primarily for Engineering Schools where already the student is trained and the faculty is experienced in methods of science and in the analysis and design functions. The range of objects or systems treated in this manner by engineers and engineering schools recently has expanded to include design and operation of more complex systems.

Hence, my first suggestion as it applies to engineering schools is merely that there is a need and an opportunity for those schools to ex-

[4] Humanistic-Social Research Project, *General Education in Engineering*, American Society for Engineering Education. Urbana, Illinois, 1956.

tend the range to include those systems called "enterprises" as well as portions of the operations therein. My remarks are not intended for Business Schools where usually the students are not trained and the faculty is not experienced in the methods of science and in the analysis and design functions. These schools present a different problem and opportunity which are handled best, I believe, by a new department which I would call a Management Sciences.

From a broad social perspective, the development of operational, or "enterprise" engineering curricula which would combine competence in the fields necessary to devise and design most efficient enterprises consistent with the important responsibilities of the enterprise in serving the diverse needs of society could lead to important steps for strengthening and enhancing our social system of individual liberties and free competitive enterprise. This enhancement would come from greater assurance that individual and social needs are better satisfied through the structure and design of the total work environment and that social and material progress is achieved effectively and harmoniously through continuous redesign of enterprises to effect social and technical innovations. These, of course, would seem to be worthy endeavors of the university level of Schools of Engineering or the Departments of Management Science in the Schools of Business Administration.

AERONAUTICAL DIVISION MEETING

The winter session of the Aeronautical Division, ASEE, will be held on January 30, 1957, at the Hotel Astor, New York City, in conjunction with the Institute of Aeronautical Sciences annual meeting. The ASEE program will be concerned with the shortage of engineers, and will be featured by a round table discussion. Principal speakers will include John Victory, Executive Secretary of the National Advisory Committee for Aeronautics; Colonel Edward Winn, United States Air Force; Robert Middlewood, Lockheed Aircraft Corporation, Marietta, Georgia, Division; and Professor John Ackerman, University of Minnesota.

GRADUATE TRAINING BASED ON UNDERGRADUATE TRAINING IN FUNDAMENTALS

R. E. PURUCKER

Public Service Commission of Wisconsin
Madison 2

Presented at the joint ECRC-Graduate Studies Conference, June 28, 1956

The subject of Graduate Training in Fundamentals is part of a larger field studied by the University Cooperating Committee,* a Wisconsin Society of Professional Engineers' special committee created a number of years ago at the request of the President of the University of Wisconsin. The committee is made up of engineers in the research, consulting, managing, governmental, operating, designing, and personnel fields. It meets regularly and has obtained the views of many persons to aid in formulating recommendations. A number of committee members keep abreast of the thinking in the educational field through active participation in such societies as the ASEE.

In its study of education as it affects industry, the committee has had the following well-known industrial facts in mind:

1. An increasing proportion of the population becoming dependent on income from industry.
2. Ordinary labor in industry is being displaced by machines.
3. The introduction of new machines is retarded by lack of persons to operate them.
4. There is an excessive number of engineering and science graduates working as technicians.
5. There is a shortage of engineers and scientists.

A study of these conditions convinced the committee that industry cannot remain highly competent and capable of absorbing increasing numbers of workers without help from all parts of the educational system.

The committee decided that conditions 2 through 5 above would be improved if more technicians were available. It, therefore, recommended the enlargement of the technical institute program to a point where eventually there could be made available to industry the 4 to 5 technicians needed for each engineer. It is recommended that the technical institutes offer high-level application courses with liberal amounts of mathematics and basic science. The state statutes already cover methods of establishing technical institutes. Local interests have only to ask for the creation of such schools and to specify the courses de-

* The members of the committee during all or part of the period the subject was studied: E. W. Seeger, F. T. Agthe, P. G. Ellis, W. A. Peirce, Arthur Simon, Harold Falk, H. K. Ihrig, E. C. Koerper, W. E. Schubert, C. W. Zachow, Orrin Andrus, R. W. Gamble, John Gammell.

sired. There exists by statutory provision a board to supervise such institutes. Because the University would not supervise their operation, the development of the technical institute program was assigned to another committee. Technical institutes have been started and the Wisconsin Society of Professional Engineers will be represented on the advisory committee covering the institute program. This committee will offer advice on courses and will acquaint local industrial areas with the possibility of requesting the establishment of technical institutes. It is anticipated that different industrial areas will request different technical institute courses. As the high-level technical training becomes increasingly available, their graduates will replace the engineers and scientists now doing technician's work; automation will not be stalemated because of lack of engineers and technicians; and an opportunity will be afforded for those who wish to receive instruction well above the vocational level.

With the initiation of a technical institute program designed to raise the over-all level of technical ability in industry and free scientists and engineers to pursue their specialities, the committee turned its attention to devising methods of educating individuals to aid in keeping industry in a position to absorb an increasing number of employees.

Obviously if industry is to expand, it must find and develop new ways of doing things; in other words, research will have to be expanded. Industry, in general, is favorably disposed toward supporting research and more and more specialists are being employed in research departments. Some of the engineers and scientists freed by the employment of technicians will move into research and thus aid in the staffing of research departments. Those who will move into the research field will be predominatingly specialists in one field or another because much of the present academic training produces physicists, mechanical engineers, chemists, electrical engineers, etc. Each field is so large and filled with so many specialized procedures, that the mastery of any one is a strenuous undertaking.

Such is the range and complexity of each field that only a few persons can be proficient in more than one.

The committee concluded, however, that the greatest need was for men who had sufficient scope of knowledge to direct a research department. Studies were begun to devise or expand existing programs of study to develop men who could coordinate the efforts of research specialists and be capable of assigning new problems to the specialist best able to handle them.

The committee did not contemplate training an administrator who would surround himself with a group of advisers representing the various specialists. Such a man would lack the knowledge to make his own decisions and would possibly tend to follow the specialist having the most persuasive personality.

The type of man the committee wants to develop is one who can analyze both the problems presented and the recommendations of specialists and arrive at his own decisions. Regardless of the nature of the courses devised, such a man could not be developed by undergraduate training

alone. He could, of course, obtain valuable additional training in industry following his undergraduate work, but the committee believes that graduate training in an educational institution would develop a broader, more basic, and more theoretical viewpoint.

After a great deal of discussion among themselves and with people from schools and industry, the committee concluded that a research director would require training which stressed the fundamentals of mathematics, physics, chemistry, and engineering from a theoretical viewpoint, and that this training should be continuous through the undergraduate and graduate years.

To implement the program, the committee recommended the establishment of a four-year undergraduate course in "Fundamental Science and Engineering."

Without thought of dictating specific subject matter, but still desiring to avoid having its recommendations misunderstood, the committee set up the following course of study.

Fundamental Undergraduate Course

28 credits in mathematics
26 credits in chemistry
67 credits in physical sciences and engineering
24 credits in general subjects

145 total credits

It was recommended that all subject matter be presented from a theoretical viewpoint and existing theoretical science courses be used. To determine whether the suggested undergraduate course could be considered a terminal course, there was further discussion with representatives of industry and educational institutions. Surveys of similar courses under different names at various educational institutions were studied. The committee concluded that the undergraduate course could stand as a terminal course and that industry would hire graduates of such a course in numbers equal to 3% to 5% of the present engineering and science graduates whom they hire.

To obtain the views of persons engaged in research, Mr. Orrin E. Andrus, a member of the Industrial Research Institute, prepared a questionnaire and made it available to the members of the organization at their 1955 spring meeting. Accompanying the questionnaire was a detailed explanation of the objectives of the course and material indicating that all subjects were to be taught from a theoretical viewpoint. The questions and answers are as follows:

1. Do you believe there is need for an engineering course such as that proposed, giving a broad and thorough training in fundamentals for those preparing for research or research supervision?

Answers

	Number	*%*
Yes	28	49
No	20	35
No Answer	9	16
	57	100

2. Would you employ or recommend for employment graduates with suitable grades from such a course?

Answers

	Number	*%*
Yes	32	56
No	14	25
No Answer	11	19
	57	100

3. Would you be interested in having the IRI committee study this matter further for a report at a future meting?

Answers

	Number	*%*
Yes	40	70
No	12	21
No Answer	5	9
	57	100

The questions refer to the undergraduate course but, as pointed out in the first question, the objective was preparation for research and research supervision. The men who answered the questionnaire were both scientists and engineers holding high research positions in industry. The committee considers the result of the questionnaire to be a strong endorsement for the establishment of the suggested undergraduate course both as a terminal course and as a preliminary for graduate research work.

Before discussing the type of graduate study that should follow the undergraduate course, it appears desirable to mention some comments that were received.

1. The suggested undergraduate course is too extensive and should be given over a period longer than four years, with appropriate recognition of the extra work at the graduate level.

2. The suggested undergraduate course will not qualify a man in any of the recognized divisions of science or engineering. This will entail additional work, not all of which will be at the graduate level before a man can be considered a chemist, a physicist, or a mechanical, chemical, or electrical engineer.

3. The undergraduate course should be followed by highly specialized graduate work.

4. The suggested undergraduate course will, in large part, better serve its purpose as a graduate course.

5. Students entering the graduate school after receiving a bachelors degree in the "Fundamental Science and Engineering Course" should be given complete graduate school freedom.

These comments have not dampened the committee's enthusiasm for the suggested undergraduate course because any of the following avenues are available to the graduate:

1. He can obtain a job at the end of his undergraduate work.

2. If he feels he must be labeled as one of the presently recognized types of scientists or engineers, he can take the necessary work although all of it would not be graduate level.

3. The student can specialize in any of a number of fields during his graduate years.

4. He can continue the study of the fundamental subjects.

Option No. 4 is the type of graduate work that is recommended for the man who is to develop into a director of research. With such training, that is, undergraduate and graduate courses in fundamentals, he will be best equipped to direct research

and accelerate the application of theoretical concepts.

In summary, the committee's recommendations indicate that the various fields of education can best help industry by

1. Expanding the technical institute program for the purpose of training high-level technicians.

2. Offering an undergraduate course in "Fundamental Science and Engineering" which stresses the theoretical approach, and covers the basic subjects of mathematics, chemistry, physics, and engineering.

3. Offering graduate students opportunity to continue study of the basic sciences and engineering without specialization.

RUTGERS CONTRACT WITH ROYAL TECHNICAL COLLEGE

(From Page 207)

chanical engineering will be of only three years' duration and will lead to the Common Part I Examination of the three British Institutions and to the First Diploma Examination of the College. The plan of instruction is typically British. Higher Diploma Courses of at least two years' duration will be established later. The College will eventually give complete degree courses.

Surprisingly enough, over 1000 students from East Africa with School Certificates applied for admission to the six faculties of the College. Limited facilities necessitated restriction of the entering class to 197 students consisting of 98 Africans, 88 Asians and 11 Europeans. Of this number, 47 were admitted to study with the Faculty of Engineering.

Financial support for the construction and operation of the College has come from several sources. The government of the United Kingdom has contributed, as have also the governments of the East African Territories. The Gandhi Memorial Academy Society has made very generous contributions and has also inspired a large donation from the Gandhi Smarak Nidhi Trust Fund in India. Various industrial concerns have contributed to the endowment fund. And, of course, the United States International Cooperation Administration will provide funds for a laboratory building and equipment.

East Africa's first engineering college is now a reality. Under the capable leadership of its Principal, Major General Colin Bullard, the College promises to have great influence on the development of the continent. It has been an exciting privilege for Rutgers to participate in its design.

For the approaching holiday season and the New Year, best wishes from the Secretariat and from the JOURNAL!

A Critique of
COOPERATIVE EDUCATION

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A paper presented to the Cooperative Education Division Conference, June 25, 1956

A few months ago a colorful yet scholarly convocation sponsored by the University of Cincinnati fittingly marked the 50th birthday of an idea that, at its inception, was considered foolhardy by most educators and unworkable by many.

In Clyde Park's book "Ambassador to Industry," he describes a typical early experience encountered by Dean Schneider in attempting to sell this revolutionary idea. Park describes Schneider's appearance before a committee of the Metal Trades group in Cincinnati with these words, "As Schneider concluded his masterly sales talk, he felt that the close attention would certainly lead to a profitable question period, followed by action formally endorsing Professor Schneider's plan. This expectation might well have been realized except for an unforeseen factor in the situation. One member of the Committee had brought with him an educator, who, being older than Schneider, was presumptively wiser. Before the discussion had proceeded far, the visitor was called upon to express his views on the subject.

Thus introduced, the guest-educator proceeded to demonstrate the possibilities of a wet blanket as a corrective for youthful ardor. Partly by what he said, but even more by his condescending manner toward the young professor and his ideas, the visitor conveyed an unmistakably negative impression. The scheme proposed might have some things to commend it in theory, but from a practical standpoint it would seem better if industry and college would each stick to its own task."

Thus ended one of the earliest hearings accorded the father of Cooperative Education by any representative group of industry.

Now, 50 years later, Cooperative Education may be considered as having survived its formative years. At the beginning of its second century of life we may ask: Is Cooperative Education on the threshold of a long and vigorous growth—or has it, in these 50 years—settled down into the serene complacency of a self-satisfied pensioner?

In short—has Cooperative Education come of age—or passed it?

Normally, in the affairs of men, a coming of age brings with it a sense of respectability, a longing for acceptance by those one respects, and a vague hope that by acquiring these two attributes, one will also be vested with attendant authority.

Now, the interesting thing about such attributes is that their realization is dependent upon the reactions of parties that have little to do with the *means* of their acquisition. Like a reputation, they attach to one by reason of the opinions of others.

Thus, that which may be considered respectable within one class of society may at the same time be regarded as highly irregular by another. Acceptance, in turn, has a disquieting way of eluding those who are unprepared to undergo and survive the critical onslaughts of the very persons from whom acceptance is sought.

Authority, finally, will be vested in one only after respectability and acceptance have been achieved. And until authority—that power or influence resulting from knowledge—is achieved *and recognized*, one is in a very sorry state, indeed, when attempting to pose as an oracle for those who would learn from him.

It seems to me, then, that on this 50th birthday, Cooperative Education has come to a point in its life where courage of a high order will be required in its next steps if, indeed, there are to be any.

I believe such steps must be taken and when they are they will require a new direction, a positive approach to questions and problems that I believe we have been avoiding these many years.

Is Cooperative Education to continue seeking respectability, acceptance, and authority in the eyes of those who view it from the placid and unruffled waters of the snug harbor of traditional conservatism—or, will Cooperative Education set its course for all to see upon the stormy, sometimes uncharted, but always challenging seas of educational high adventure?

For, mark you, Cooperative Education *is a different form* of higher education. It requires a daring, a break with stuffy traditionalism, and it provides an exciting voyage for those with the courage to break with the old. It provides, in like measure, the most dangerous kind of shoal waters for those who are content to stay always on the lee of a heavy blow.

It was a willingness, indeed, an inner compulsion to break with tradition, that enabled Herman Schneider to give birth to the idea of Cooperative Education in the first place. Clyde Park says, in speaking of Dean Schneider: "His contact with conservatism had repelled him to the point where he often quoted with approval Stevenson's words: 'For God's sake give me the young man who has brains enough to make a fool of himself.'"

I say to you, then, if Cooperative Education *is different*, requiring different methods, and a different breed of men to implement these methods, it is time now for Cooperative Education to say so. But to say so with *conviction* requires a comprehensive knowledge of our field that, I fear, may still be lacking.

Some in this audience may recall the proposal I made at our Annual Meeting at Rensselaer Polytechnic Institute a few years ago. At that meeting I suggested that it was time for Cooperative Education to engage in a study of itself in order to establish a Code of Principles which would serve as a guide for all schools wishing to be recognized as Cooperative Educational schools.

Cries of dismay greeted that proposal. Some accused me of wishing to establish an accrediting body or of wishing to set up a "cominform" organization to police the field. Indeed, some, unknowingly, added purpose to my proposal by crying that the suggestion was preposterous and unworkable because of the great diversity of programs that existed!

It is precisely this recognition of a

diversity of programs that still gives me reason for concern and the courage once more to call attention to this Achilles heel in any attempts to gain *full* and cordial recognition of Co-operative Education.

I am absolutely convinced that if Cooperative Education is ever to acquire the universal professional recognition it rightly deserves on its own merits, it must very soon present a unified, understandable, and workable set of principles by which it as a Program, or any school, as a part of that Program, may be judged by independent and objective agencies.

Some may now charge that I am laying the groundwork for the very sort of conformance that I deplored only a few paragraphs back. But, I say, this is not so! Frequently, the difference between conformity and enlightened dissidence is little more than a change in direction. In advocating a chart and a plan, I do not at the same time seek to turn the ship about. On the contrary, the more hazardous the voyage the greater the need for orientation points—but the points I seek are the stars of the limitless horizon and not the anchored lighthouses of the well traveled sea-ways.

No, Cooperative Education needs a *positive* direction, but one which is outward and onward. I ask each of you what, in your span of contact with the Program, have you found to be really new? I venture the guess that few would care to answer that question, and if this is so, I hold, that it is because we have not yet agreed on where we are *NOW!*

Nowhere did this lack of definition show up with more startling and dismaying clarity than in the days of the Second World War. At that time I was Chairman of this Division's Committee on Relations with the Federal Government. In that capacity it was necessary to have numerous discussions with both the Civil Service Commission and the Selective Service Commission regarding both the status of certain schools purporting to have Cooperative Education Programs, as well as about students enrolled in those schools.

Again and again questions of operating principle were raised by those agencies about one or another of the schools or the students enrolled therein. Again and again it was impossible to respond adequately and knowingly to these questions for lack of a common denominator against which to judge matters under consideration.

It *is* a matter of record, on the other hand, that some Co-op schools were eminently successful in obtaining deferment for their students while others were equally unsuccessful. Does it follow from this that these latter schools were any less professional than the former? From personal knowledge I can attest that this was not always the case. The plain facts are that some schools were more adept—more persevering—and by reason of geographical location—more strategically able to present their case to headquarters in Washington.

Now this type of pleading with the Government in itself is not unique or unusual. What did disturb me then, however, and what disturbs me now, is that the point of reference when deciding a question all too often was based on some concept inherent in a program that either had the strongest advocate, or was the oldest, or was the most publicized. Not once, to my knowledge, was a reference point established that allowed anyone of us to say with authority that this or that

principle was one subscribed to by *all* professional schools of Cooperative Education. Indeed, we could not even agree on a roster of all professional Cooperative schools.

This state of affairs, I submit is hardly conducive to a feeling of confidence within some supra-agency like Selective Service that any set of data presented to them in behalf of Cooperative Education is, indeed, representative of the whole.

What then is required?

I propose that those who are today the rightful heirs of Dean Schneider's leadership should now call for a study of the elements constituting a professional, collegiate Program of Cooperative Education.

In making this proposal, I am well aware that in 1946 a masterful presentation of the *aims* of Cooperative Education was submitted in a paper entitled "The Co-operative System—A Manifesto." This paper was prepared by the Committee on Aims and Ideals of Cooperative Education under the chairmanship of Dean C. J. Freund of the University of Detroit. Its mandate was acclaimed then and is still valid today, and I subscribe to it heartily. What I am proposing now is a companion study that will uncover and set down the *means* required to reach these aims and ideals.

We might take a leaf from the book of the accrediting agencies in considering this. As you know, an accrediting review team studies the curriculum content, contact hours, manning tables, and space requirements of a certain program and then by comparing their findings against a previously agreed upon norm for each of these areas, they arrive at a decision with regard thereto. In much the same manner, I believe that Cooperative Education has now arrived at a point where somewhat the same procedure could be followed in passing upon its status.

But, note this: The norm for judgment must *first be established.* Usually, any norm is the leveling of extremes. But this norm, unlike an average, need not be "the result obtained by dividing a sum by the number of quantities added."

Let me illustrate by oversimplifying. Suppose such a study should uncover the fact that 80 per cent of the schools reviewed do not require written work reports and 20 per cent do. It need not follow therefrom that the norm lies somewhere in between. Indeed, the right kind of professional study might result in a recommendation that no reports whatever are necessary—or that reports undergirded by oral presentations should be required of all.

Such a compilation of criteria would serve not only as a basis for any future dealings with supra-agencies such as Selective Service, but more importantly would give each of us a valid basing point for the review and extension of our own programs.

Additionally, such a Code of Principles would provide the guide that is being sought by more and more schools that are contemplating the establishment of Cooperative Education in their institutions.

Throughout the years that I have been attending these meetings, I have been struck over and over again by the eagerness with which numerous school representatives are seeking guidance and assistance in their consideration of the question of whether their schools should undertake a program of Cooperative Education. I confess that a sense of inadequacy has

overwhelmed me repeatedly when I listened to the all too often vague and frequently pointless responses that were given to pointed questions.

Certainly the value of Cooperative Education has not been enhanced in their eyes to any great extent by repeated assertions that "each school must work out a program suited to its individual needs" or that "what works one place won't work at another."

The cold and unpleasant facts are, I fear, that we simply have not yet found agreement among ourselves in defining the basic principles required to achieve the recognized aims of Cooperative Education. Until such agreement can be found, it seems to me that we are in a most vulnerable position if we, individually, attempt to promote "our" program as *the* Program of Cooperative Education.

I suggest that the kind of study I am proposing here, is the most sensible approach to this whole problem. Its undertaking will require courage, tolerance, and patience. It will prove unpopular with some and it will undoubtedly tread on some toes—but it must be done.

I see it as progressing in three stages which I have headed as follows:

Administration
Interpretation
Association

Under *Administration* I would hope to see an exhaustive analysis of exactly what is needed to operate a program of Cooperative Education. Questions of personnel, facilities, finances, student load, credits, work periods, faculty attitudes, and all the other countless problems inherent in the operation of a program would be reviewed here with a view to arriving at specific recommendations.

Under *Interpretation* I would hope to see a study made of the printed statements regarding Cooperative Education out of which would come some specific recommendations regarding what Cooperative Education is and what it is not, and what claims may validly be made for it.

This then brings us to *Association*, the most important of the three steps I envision. Without agreement on this step the whole of my proposal would be for naught.

I would hope that as a result of this proposed study a new and inclusive *Association of Cooperative Colleges* would emerge. It would be an Association embracing and recognizing all schools—not just those offering engineering—that would agree to abide by the principles adopted as a result of this study. I would not ask for accrediting powers for this Association, but I would hope that by its rigid adherence to the principles evoked by this proposed study, it would come to be recognized as the voice for all Cooperative Education. Under these circumstances, membership in the Association would be sought eagerly by all those who truly wish to be recognized as schools of Cooperative Education, and the advice and opinion of the Association would become authoritative in the eyes of other agencies.

Such an Association could render immeasurable service to the whole field of those schools already committed to this form of higher education, while its force for good in assisting those contemplating the establishment of such programs is incalculable.

This Association also would provide the respectability, the acceptance and the authority that is the rightful legacy of *all* professional programs of Cooperative Education—be they En-

gineering Programs or not. To fail to provide these non-engineering programs with the recognition they deserve is to continue in a state of provincialism that will constantly delay full acceptance of collegiate Cooperative Education.

Finally, there comes the question of how to finance such a study. I can only guess on this point, but I have the feeling that a well documented presentation of the need for such a study, forcefully presented by some of the leading figures of Cooperative Education to some of our forward-looking foundations might result in a substantial grant of money.

Whatever the means, I have the deep and unswerving conviction that this is the step that must be taken at this outset of the second half century of Cooperative Education.

In closing I recognize that what has been said may be an irritation to some. They have heard it all before and, I daresay, they wish I would stop repeating the theme. It reminds me of a story about the great actor Frank McGlenn.

This fine actor spent his life doing Lincoln, both on the legitimate stage and in the movies. In his living-room he assumed Lincoln postures, he walked like Lincoln, dressed like Lincoln.

On this particular day he was coming out of his apartment in the habiliment of Lincoln—top hat, frock coat, striped trousers—and when he reached the sidewalk he surveyed one end of the block and then the other, very deliberately, and then with long strides, very similar to Lincoln, he walked up the street.

A fellow standing across the street watching him said, "Look, that guy will never be satisfied until he's assassinated!"

DO YOU KNOW (From Page 195)

If you are interested in these and the other publications of ECPD, they can be purchased from S. L. Tyler, Executive Secretary, ECPD, 29 W. 39th Street, New York 18, New York.

► . . . . That the Newsletter of the Engineering and Scientific Manpower Commissions, No. 97—Sept. 11, 1956, contained the following statement? "The class of 1955 produced 3754 fully prepared prospective teachers of science; 2114 of them entered teaching last September. At the same time, school officials employed 4152 new teachers to devote more than half time, and 2587 new teachers to devote less than half time to the teaching of science." "The situation in mathematics was no better, NL No. 95, July 12, 1956."

W. LEIGHTON COLLINS
Secretary

THE MOTIVATION OF ENGINEERING STUDENTS IN THE STUDY OF ENGLISH

S. REID WARREN, JR.

Assistant Vice-President, undergraduate engineering affairs, The Engineering Schools; Professor of Electrical Engineering, Moore School of Electrical Engineering; University of Pennsylvania, Philadelphia 4

A paper presented to the joint session of the Divisions of English and of Educational Methods on June 25, 1956

It is the purpose of this paper to delineate some of the problems associated with the education of students of engineering to a broad professional outlook on living. The essential conclusions are: First, that education of engineering students in humanities and social studies is the responsibility of all teachers of such students; second, that this responsibility goes far beyond the process of blocking out a certain number of hours for courses in these fields; and third, that the major objective in this area is to stimulate the student in such a manner that he will develop for himself throughout later life knowledge and understanding of the broad aspects of human endeavor and human intercourse, outside science and engineering.

Employers of engineering graduates appear almost unanimously to believe that these young people do not know how to speak or to write effectively. There also appears to be a reasonably large group of people who think engineers are uncouth individuals who consider "culture" and "gadgets" to be synonyms.

How much of this view is based on observations of recent graduates; whether or not the opinion is founded on reasonable standards of judgment; these things are unknown. The criticism is nevertheless directed to the colleges, and there is certainly enough "smoke" to justify looking for the "fire."

It is unnecessary, and perhaps irrelevant, to examine the present situation in much detail. All engineering students have formal courses in speech and writing, and in literature or other topics in the humanities. Many study in regular courses the special problems relating to engineering reports. Important questions for consideration now are, therefore: are there ways of enhancing the effectiveness of the present courses; and are there ways of supplementing the education of the student in the areas of communications and humanities by changing the methods of teaching other courses?

The remainder of this paper is devoted to partial and personal answers to these two questions. It turns out that answers to the two questions are interdependent. Partial answers to one are simultaneously partial answers to the other.

Why Study English?

Most engineering freshmen think that a good engineer is a man who can solve many differential equations and then construct devices that are useful analogs of the equations; they expect to learn such things in college. Accordingly, the freshman is strongly motivated to study mathematics, and

even physics and chemistry, with some enthusiasm. When he is faced simultaneously with a course in composition and speech, or literature, or history, however, he is likely to resent the intrusion on the time he wants to devote to mathematics or physics.

There are two important inferences with respect to the freshman at this stage. First, he need to be convinced that there is something more to living —as engineer or as something else— than science and technology. Second, he should meet oral-written communications and the humanities in such a manner that he develops enthusiasm for and personal interest in them.

Engineering teachers and teachers of mathematics and science can contribute to the achievement of the first objective; they may contribute modestly to the second. If every instructor of engineering students insists upon effective and concise speech and writing in all aspects of his course, the students will soon be convinced that such matters are important. If insistence upon effective and efficient practice of communications does not permeate the whole curriculum, it is unlikely that the efforts of the teachers of English will be successful.

Perhaps an example will make this clearer. A section of junior electrical engineering students were told at the beginning of a course in field theory that final grades would be determined by the instructor's judgment of three items: (1) grades in quizzes and final examination; (2) demonstrated ability to express clearly and effectively—in speech and in writing—knowledge and understanding of the concepts and methods that form the course; (3) demonstrated ability to correlate the subject matter of this course and others taken before or concurrently.

The students raised a few questions, particularly about the instructor's judgment with respect to clarity and effectiveness of speech and writing. The course then proceeded. One young man turned in his first hourly quiz paper, which had precisely the right answer, but which was so confusingly written that it required nearly one-half hour of very careful scrutiny to discover how the problem had been solved. Faced with the failing grade of F, this student came to the instructor's office and "blew his top."

The instructor reminded the student of the requirements of the course and refused to consider changing the grade. The instructor then went into class and reported the incident, describing the conversation with the student and mentioning his name. From that time on there was a notable improvement in the care with which the students organized their answers to quiz problems.

If he does it properly, an instructor can correct a student in class for misuse of the English language during discussions. Such corrections may be disturbing to the student; but if made with tact and sympathy, the reactions are usually good. This is particularly true if the instructor does not confine his corrections to those based on specific rules of grammar or pronunciation, but rather deals with usage of the language, which is important to all.

Such activity in an engineering course does not take much time. If such practices were followed by a reasonable majority of teachers, then the student would soon become convinced of the need to formulate his habits of speech and writing in accordance with practices that are generally acceptable. In other words, we as teachers of engineering must help

the teachers of English in this important problem in the development of our students.

What Good are the Humanities?

It has been pointed out in the introduction that students who enter engineering schools have deep motivation toward the learning of mathematics and physics and engineering. By and large, they are young people who have already acquired a great respect for facts which are based on repeatable experiments, and for the mathematics which enables these facts to be expressed in terms of symbols or as numbers.

Such young men and women often lack any appreciation of the vast areas of man's knowledge that involve *ideas*, which cannot be expressed quantitatively. These include the subjects of philosophy, history, literature and art in other forms, and many areas in the social sciences. Engineering educators recognize this difficulty. They continually seek methods which will impress upon the student the importance of these areas in the education of the whole man.

Unfortunately engineering educators sometimes give no more than lip service to this problem and to its possible solution. However, the full impact of the comments of alumni, representatives of management in industry, and others is now being felt.

There is a conviction which is permeating the profession of engineering. It is the conviction that a truly professional engineer is a man who, by his ability for thought and action, can solve new problems which are based in science, but which have components dealing with people and their interactions. As soon as one is convinced that this is so, education in the humanities and social sciences becomes a practical problem.

At this point it is easy to make a mistake. There is an implication in the last paragraph that what is needed is a series of training courses that will tell the engineering student just what he needs to know about psychology, sociology, economics, literature, art. This is of course a subversive idea.

A basic justification for the freedom of the individual in the United States today is the idea that each man has the privilege to develop his own mind and body and spirit, and the obligation to contribute to his own progress and that of his contemporaries. Therefore, each individual needs to be stimulated to develop himself. This is perhaps nothing more than an involved translation of the word "educate" which, of course, means "to lead" or "to bring out."

Now, then, is it possible to convince a young person that he has within himself a need for, and probable ability in, the thinking and feeling that are associated with many phases of the humanities and social studies? This is a topic far too extensive for discussion today; but there are some aspects of it which are closely correlated with what has been said in the first two sections of this paper.

The first point to be made is that present courses in the humanities are very likely to be inappropriate for any student except one who wishes to major in a particular field of which such course is a part. For example, the first course in English literature at my institution is entitled *The English Language and Early English Literature*. If the author of this paper is a reasonable example, there is no more effective way to discourage a young man's interest in English literature

than to try to teach him something about *Beowulf* and the *Canterbury Tales* [*] in their original forms. On the other hand, it would appear worse than useless to present a course based on a few selected items in English literature which the student would certainly enjoy reading. This would be the "Survey Course" at the worst level.

The same critical comments can be leveled against courses in other areas of the humanities and social studies, but here there have been some interesting attempts at solutions. For example, the economists have devised fundamental courses at a reasonably high scholarly level which combine a discussion of principles and a description of some applications of principles. It turns out that such a course may be simultaneously satisfactory for a student of economics, an engineering student, or a student of the liberal arts who wishes to elect a course in economics. This appears to be a very fruitful line of endeavor.

The remainder of this section is devoted to a brief description of a course entitled *Collateral Reading* which was introduced by Harold Pender—who was then Dean of the Moore School of Electrical Engineering—in 1926 and which continues in a somewhat different form to the present day. The course, or sequence of courses, has been presented to sophomores, juniors, and seniors; and sometimes for as many as four terms, for the regular students of the electrical engineering curriculum.

The presentation of courses in *Collateral Reading* is based on two assumptions: (1) The student has had courses in English and the humanities under the auspices of the departments of those subjects; (2) the chief purpose of *Collateral Reading* is to stimulate interest in the humanities and not to teach facts or even ideas. The course requires one hour per week in class. Sections are usually no larger than fifteen students. The instructor is a member of the staff in electrical engineering who has volunteered.

The actual procedures in the course vary from year to year and from one instructor to another, but perhaps one example will make clear the general principles. One instructor likes to meet his class for the first hour for a discussion and a determination of the work of the term. He points out that he would like to have the class agree upon the titles of three or four books which they will read and discuss during the term of sixteen weeks. He limits the recommendations of books to those which have nothing to do with science or engineering. He offers examples from books that have been used in previous years. The class discusses and makes suggestions and by the end of the hour the program has been specified and the first book assigned for reading within the next two weeks. As one example of the books so selected, the following are illustrative for one term: *Language in Thought and Action,* by S. I. Hayakawa; *Modern Men of Art,* Charles Craven; *Three Plays,* Henrik Ibsen; *Life of Voltaire,* Tallentyre.

The class hours are devoted mostly to free discussion among the students with occasional comments by the instructor; a few quizzes are given as a sop to academic tradition. The discussions have many facets. It is surprising how much one can learn about

[*] I discovered some aspects of the perception and depth of Chaucer's mind at the age of forty-two by reading a modern version of the *Canterbury Tales* and then several others of his works.

an individual student by watching him perform in this course. It is almost certain that the instructor will learn more than the students, about people, if not about the subject matter of the course. Finally, it is fascinating to watch some of the students who originally sneer at the course as a waste of time, but who complete the course with a newly-developed enthusiasm for some area touched upon by the discussions in the course.

There are many ramifications of this procedure which various instructors have tried from time to time. Thus an occasional hour has been devoted to the showing of colored slides of works of painting or sculpture; and occasional hours are devoted to the playing of music from records. On one or two occasions the instructor has arranged for the class to attend opera, ballet, play, or museum.

It should be strongly emphasized that the description of *Collateral Reading* is not presented here with the idea that it should be instituted in other schools. It is an example of methods. Different schools will use different methods depending upon the objectives of their staffs. However, this course does illustrate a general principle: It is entirely practicable for the staff of an engineering school to contribute to the development in each student of an interest in humanities.

INSTITUTIONS IN UNDERDEVELOPED COUNTRIES (From Page 210)

similar work is done in the Arab countries by the American University of Beirut and by other schools and teams and individuals who have gone to the national institutions struggling to make a beginning.

The opportunities are great and challenging and our own resources of personnel are limited. We shall hear more of that in the discussion of "the College Faculty Crisis" which is to follow. That crisis is very real, and we at Robert College and elsewhere overseas feel it just as you do. But I suggest that together with the domestic crisis we must also face the challenge and the opportunity overseas in the underdeveloped and contested areas of the world.

I would respectfully suggest that an association such as this might well create a committee or commission to consider what can be done by the engineering schools and profession of America and how it should be done.

And I would conclude by saying once again that the world today is a city, and the voice of the town crier can be heard across it. We cannot afford not to hear that voice.

COLLEGES, SCHOOLS, AND THE MATHEMATICS CURRICULUM

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A paper presented to the Mathematics Division Conference on June 25, 1956

The sequence of mathematics courses in the schools should reflect the changes that take place in our social, economic, and scientific world. For the past decade our schools have been criticized because they do not reflect certain basic changes that have taken place in our technological society. The courses and their contents are still geared to a social and scientific order that has shifted its center of gravity. Under such conditions the schools cannot serve society as they should.

Not since the last quarter of the nineteenth century has there been such dissatisfaction with the mathematical curriculum of the secondary schools. This, too, was a period of rapid political, economic, and technological development in the United States. The schools, however, did not change as rapidly as did the total social situation. As a result, demands were made on the schools to keep up with the rapid pace of scientific development. The result was the famous *Report of the Committee of Ten on Secondary School Subjects* [1] published in 1894. This report and the recommendations of the Committee on College Entrance Requirements [2] published in 1899 were responsible for the basic sequence of mathematics courses commonly found in our public schools today.

Since the publication of these two reports, many other studies of the mathematics program in the secondary schools have appeared. These studies, however, were more concerned with the improvement of mathematics within the framework set up by the two committees previously mentioned.

The present feeling of dissatisfaction with the mathematics curriculum occurred under circumstances somewhat similar to those of the latter part of the nineteenth century. Since World War II there has been a rapid technological development. New techniques have been developed in all fields, but the mathematics of the elementary and secondary schools and, in part, the colleges have not always reflected this change. Hence, the demand for a more contemporary mathematics for the first fourteen grades of the schools of America.

As in the nineteenth century, these demands have resulted in the appointment of committees to study the situation. One of these committees has already published a report.[3] Others

[1] "Report of the Committee of Ten on Secondary School Subjects" (New York: American Book Company, 1894).

[2] A. F. Nightingale, Report of the Committee on College Entrance Requirements, *Proceedings and Addresses of the National Education Association*, Thirty-eight Annual Meeting, 1899, pp. 648–651.

[3] "College Admission with Advanced Standing," The School and College Study of Admissions with Advanced Standing (Wil-

have not completed their studies.[4] Even though some of these committees are still deliberating, it is possible to predict the general pattern of the contents of the reports which are likely to result from the various studies of the mathematics sequence for the high school.

The demands for reform of the secondary mathematics program, as considered in this article, will be discussed under three headings; namely, (1) topics and courses to be eliminated from the high school curriculum, (2) the contemproary mathematics which should be introduced into the high schools, and (3) the role of the colleges in the development of a better secondary program.

Topics and Courses to be Eliminated

Fifty years ago the secondary schools and academies discarded such subjects as navigation, surveying, and mensuration for a mathematics more suitable to the times. Today the schools are being asked to make a similar adjustment. Consider just a few examples of the adjustments that the schools should make.

Computational trigonometry is being emphasized out of all proportion to its usefulness and importance. The modern uses of mathematics demand an adequate knowledge of the trigonometric functions and their properties instead of skill at solving triangles through the use of logarithms. Undoubtedly, the demand for surveyors and certain historical considerations dictated the emphasis now placed on the solution of triangles. Today, however, the ham radio operator and the electrical engineer need a course which places more emphasis on the analytical aspects of the subject. For these reasons many people feel that the high schools and some of the colleges are wasting valuable time when they emphasize fully or unduly the computational aspects of trigonometry. Indeed, there is real reason to believe that a semester course in high school trigonometry cannot be justified in the light of the many demands for a knowledge of the more contemporary aspects of mathematics.

One often hears that the schools of today spend too much time elaborating unimportant details. To drive home this point, the critic of the present organization of mathematics courses will cite solid geometry as an example. Why not eliminate solid geometry as a course and place the more worthwhile elements of solid geometry—perspective, mensuration formulas, and the generalization of certain plane geometry theorems—in the plane geometry course; thereby saving one-half year's time for more worthwhile mathematics? This suggestion seems to meet with increasing favor. To spend three semesters studying high school geometry perhaps prevents the student from studying a more powerful and useful branch of mathematics.

There are other suggestions for eliminating antiquated mathematics from the high school curriculum. Some feel that Euclidean geometry should not be studied in the second-

liam Cornog, Central High School, Philadelphia, Pennsylvania, 1954).

[4] The College Entrance Examination Board has appointed a Commission on Mathematics under the chairmanship of A. L. Tucker, Princeton University, and the National Council of Teachers of Mathematics has appointed a Committee on the Secondary School Curriculum under the chairmanship of Frank Allen, Lyons Township High School, La Grange, Illinois.

ary schools. The arguments in support of such a statement have considerable point and will undoubtedly bring about a change in the form and content of the year of geometry now taught in the schools. The principal argument against plane geometry is that it is necessary to develop a very extensive set of postulates, definitions, and undefined terms before one is actively on his way toward building a mathematical structure. By comparison, the postulates of a field or group are much simpler; at least, they are not as extensive. However, there is reason to question whether the high school student has sufficient mathematical maturity to grasp the spirit of the modern approach to algebra when he is introduced to structures by way of the postulates for a field or group.

It would seem that proposals of the *School and College Study of Admissions with Advanced Standing* (pp. 39–45) are more feasible than the proposal just mentioned. This study recommends that the plane geometry course consist of several simple mathematical systems rather than one large Euclidean system. The systems might include some of an algebraic nature and some from the field of arithmetic.

These and other minor topics constitute the major part of the curriculum which can be classified as "time not wisely used" for the high school student. The chief difficulty with this type of mathematics in the high school is that in some instances the student is held back in his mathematical development and in other instances he is not brought into contact with enough contemporary mathematics to enable him to undertake a serious study of the sciences when he enters college. If the student's time was wisely used in the high school, he would be more advanced in his study of the scientific subjects when he received his B.A. degree. This, of course, would be a distinct advantage to society. But what are the proposed new materials for the high school?

Contemporary Mathematics for the Schools

The proposals for substituting other mathematical topics for those now taught in the schools are numerous, but here again it will be necessary to deal with only the more frequently mentioned, and the more plausible proposals: (1) The high school student should be introduced to the elements of probability and statistical inference, and this introduction should make liberal use of the language of sets, (2) The elements of analytical geometry should receive much more attention in the high school, in fact, it should be an integral part of any four year high school program, (3) The elements of the calculus should be taught in those high schools with sufficient enrollment to justify such a course. Here opinions differ sharply. Some college instructors think an introduction to the calculus would be desirable for a full year's study of the subject in the freshman year of college; others feel that if the high schools cannot offer a full year of calculus the study of the subject should be postponed until the student enters college. Certainly for schools which start algebra in the eighth grade, and this is becoming an acceptable practice in many areas, a full year of calculus in the senior year is easily possible. This practice should be encouraged by all concerned, not only because it opens the door to the cal-

culus in the high school, but also because the present seventh and eighth grade program wastes the time of the more capable student.

In addition to substituting other mathematical topics for some of the mathematics now taught in the schools, there is a need for placing an emphasis on the fundamental mathematical ideas in addition to the development of mathematical skills. For example, it is more important that the student know the properties of the logarithmic functions than it is for him to be facile at the use of the logarithm table. There is a growing feeling that high schools and colleges rely on drill too extensively.

There is also the need for modernizing the terminology of the elementary courses. Such definitions as "Variables are quantities that vary," are psychologically bad and mathematically bad. They have no place in a modern high school course.

The Role of the College

Any proposed revision of the high school and college curriculum in mathematics cannot reach its ultimate goal, (that of rapidly advancing all students in their study of mathematics, in particular, the student with outstanding ability) if the articulation of the high school and college program is not given considerable attention by all groups. High schools, like colleges, differ in kind, differ in degree of educational attainment, and differ in purpose. Students of varying degrees of ability and educational background will come from any high school. For those colleges which do not have high admission standards, it is a difficult task to provide a program in which the intelligent student with a weak background has a chance to find himself. The colleges are now struggling with the problem that the high schools have faced for some decades. It is significant that the report *College Admission with Advanced Standing* recommends that college credit be given for high school work well done. Such practices recognize the extreme range of ability and mathematical attainment that exist among high school graduates. Colleges should encourage this movement.

In any reform of the high school program, the colleges must give positive leadership. However, it is essential that this leadership be such that the high schools are given a free rein to develop a strong mathematics program. It is indeed a rare occasion when a group of secondary teachers discuss curriculum revision that they do not encounter blocks set up by neighboring colleges. The problems of reform are joint problems and, as is always the case with such common problems, each party has its own particular assignment which must be met if the schools are to arrive at a satisfactory solution. The blame for the kind of mathematics program we have must be shared by the colleges. The problem will be well on its way toward solution if the colleges will recognize this as being true.

There can be little doubt that in the next decade there will be a marked change in both the secondary and collegiate mathematics programs. All will agree that some reform is necessary. However, the movement will not reach its full fruition unless the college people make an effort to get acquainted with the tremendously complex problems faced by the teacher of mathematics in the secondary school. The failure, if it is a failure, of our

mathematics program in the elementary and secondary schools does not rest entirely on the shoulders of the teacher or the administrator. The schools can be no better or no worse than the ultimate aspirations of the community, the state, and the nation. Within this framework the teacher must operate, but the results are not always conducive to a good educational program. To recognize that it is the total system of education that is at fault and not the teacher will do much to provide a sound basis on which to reform the mathematics program in our schools.

ICA–WISCONSIN PROJECT IN INDIA (From Page 204)

a high appreciation of educational facilities which have been open to them, the opportunities to travel, the cordial receptions they have encountered, and the care which has been taken in looking after their welfare and programs. Hence, in this field of participation the evidence submitted also indicates that the program is fulfilling its objectives.

COMING EVENTS

In January:	*10–11,* Cooperative Engineering Education Northeastern University, Boston, Mass.
	30–31, College-Industry Conference University of California, Los Angeles *Theme: Improvement of the Engineer*
	31–Feb. 1, Midwinter Drawing Meeting Rice Institute, Houston, Texas
In March:	*10–16,* Second Nuclear and Science Congress Philadelphia, Pennsylvania
In June:	*17–21,* ASEE Annual Meeting Cornell University, Ithaca, New York

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PROFESSORS VS. ENGINEERING EDUCATION

HIRAM BROWN

Company Chief Metallurgist,
Solar Aircraft Company
Des Moines, Iowa

A paper presented to the Conference of the Educational Methods Division, June 25, 1956

In recent years we have heard many times that the institutes of higher learning are faced with a shortage of professors. I am not one who subscribes to that theory. On the contrary, it seems to me that there is, already, an adequate supply of professors. What we do need are teachers. There is certainly a difference between these two titles.

Many of us who spend a great deal of time trying to locate good engineers are often very discouraged by the attitudes of the young graduates we interview. Many of those attitudes, I believe, begin in college and are inherited from some of the professors. I should like to discuss some of those shortcomings and give my opinion as to how they can be absorbed by students.

For one thing, the new graduates appear to be interested only in how much they can gouge out of industry due to the shortage of engineers. Little thought is given to the creative nature of the work or what it means to society, or even what it means to the individual himself. They seem completely unaware of the great satisfaction that can be derived from the feeling that theirs is the best darn profession in the world and that they can make it even more so if they like it and do a good job. Most of them, instead, have the attitude, "Well, the pay is good." Why do they feel this way? Well, I have had professors from prominent engineering schools tell me that they would not let their boys even go out for an interview if the starting rate was less than $500 per month. No mention was made of the type of work or its potential for development of the individual. I interviewed none of their students.

During the course of "teaching," how many professors take time to make the technical fields seem appealing or challenging, or, yes, even enjoyable. Most of them are too busy polishing up the hard facets of technology, so let someone else teach the other phases. Someone else may teach the finer things in life, but it would mean a lot more if the students detected the same attitude in their technical instructors. Can it be that the professor himself believes that only technical facts and salary are involved, but no personal feeling? Is lack of professional pride due at all to the apologetic attitude of many professors who constantly bemoan their fate as low paid educators whereas they could make a lot more money in the industrial field? Some of them could, but such an attitude encourages students to put monetary considerations above all else, and to give little value to aesthetic considerations. Actually, teaching is a very honorable, necessary, and constructive profession and no teacher need be ashamed or

apologetic for choosing it. Most teachers would be far less happy, even though richer financially, in some other field. If the inner satisfaction he derives doesn't offset his low salary, he isn't chained to his post, so why subject students to his frustration?

Many graduates have a poor attitude toward their job and have difficulty getting along with other personnel in the shop. Some even resent the fact that they must often go into the shop or the mill rather than staying in a nice air conditioned office or research laboratory all day. Is this due to the fact that they have not been conditioned for this possibility in school nor told what shop experience can mean to them in the long run? How many professors really know anything about industry except for a few "field trips" they take with the boys? Most of them haven't the slightest idea of what the practical applications are for the theories they are teaching. Many of them have recited from the same basic textbook so long they know it by heart. If there is a textbook surely the student can read it himself outside class. Why shouldn't the professor inject into his lectures the practical, industrial coordination with theory. If he doesn't know it, why not occasionally bring in an outstanding man from the industrial field to cover those points.

The student is given little orientation in regard to what he can expect in the shop, so how can you expect him to fit into the industrial picture where the atmosphere and personnel are entirely different from scholastic circles? I once knew a professor of metallurgy for whom I had the greatest respect. The first thing he said to every class was, "I may not make metallurgist out of any of you, but I'll make men of you or you won't finish my course." He expected students to read the necessary books, so he spent class sessions telling the students about industrial practices and how to approach a problem in the shop without losing the respect of other workers. I wish there were more like him!

Many engineers will not accept criticism, admit an error, or even consider the possibility of any other interpretation of data than their own. Where does this come from? Well, most professors have at hand the source of all knowledge—a textbook. They often run research projects designed to prove or test some of the theories. They melt a few small lab crucibles of metal, analyze the results, and submit a paper to some technical society. In the technical society some experienced and practical men analyze it and either disagree with the results or find that the data presented are not adequate to prove the point.

They suggest certain modifications or further work. What happens? Well, I can tell you from personal experience with professors from some of the best known engineering schools. The society is promptly told, "I am Dr. Snafu of Screwdup University. Either you peons publish the paper as is or else you'll get no more contributions from our group." I have had the pleasure of often accepting that "or else." Do you think such an attitude is not carried over into their teaching?

While we're on the subject let me deal a little more with those publicity-seeking professors who pass themselves off as educators. Unfortunately, many of the larger and more publicized schools like to have a number of prolific writers on the staff. It advertises the school, attracts national at-

tention, and presumably has something to do with financial rewards from the alumni. What do many of those men do for—or should I say to —the students? First of all they consider themselves too good to teach undergraduates. They will condescend to teach graduates since somewhere along the line maybe they can get their name attached to some advanced thesis work being done. What about the undergraduates? Those they gather in groups of 100 or more and lecture, often by use of a microphone. This is education? This is developing young minds? Let it be granted that such a professor is famous, but should he really be considered a teacher? Why not simply mark him off as a public relations asset?

Please don't tell me these things aren't being done. I have lectured at a number of universities and have seen such tactics. Furthermore in an active career in technical societies I have dealt with these men. Just try to get one of those egocentrics to stick to a time schedule at a technical meeting. He feels he is entitled to do as he pleases and is indignant when he is cut off. This is an example of humility and how to endear yourself to your fellow man?

One of the greatest deficiencies I find in young engineers is their almost complete lack of curiosity. Science is primarily a field of enquiry, a business of how, and when, and where. Yet you can give a project to some of these men and they will never see anything that defies explanation and needs looking into. They are not perfectionists in seeking all the answers, those that are unanswered are treated as exceptions that prove the rule. No greater fallacy ever existed. No exception ever proves a rule, except in the opposite and correct sense of testing or straining one.

What do the professors do to stimulate the curiosity of their students? Certainly this can't be done by textbook reading and mass technics of teaching. Small, intimate groups, and even individual discussions are desirable. This is often impossible from shortages of teaching personnel. I wonder if sometimes, however, it isn't done because the professors are a little bit afraid of being jarred out of a nice quiet pattern of beliefs. I believe some professors use the teaching profession to escape from the impact of ideas outside their ivory tower. They are simply not stimulating persons themselves but don't want it to be found out. They certainly don't stimulate the students.

Too often engineers start to make a report with preconceived opinions based on limited observation and the book theories they may have learned. If any theory can be made to fit some of the facts then that becomes the only answer. Tests may even be based on preconceived ideas. Rationalization, thorough and orderly study of facts does not take place. Perhaps this is another result of lack of curiosity or of smug self satisfaction. Generalizations are common because they are easy and not too challenging to the imagination.

Many times reports are not directed to the potential readers, but to the writer himself. The writer fails completely to project his ideas. Thus he fails to sell his services as well as he might. The report must answer the needs of the readers. Many times, because reports are not written for public consumption, the writer is upset by questioning of his report.

He may say, "That's not what I meant—you're reading it wrong." Often he cannot even explain what he means except with highly technical, stylized words. This shows lack of fundamental understanding of the subject matter, and is often due to mass indoctrination by means of large classes or too little opportunity to wrestle with technical phrases under the close guidance of a teacher.

Under such a system good students cannot progress as rapidly as their ability would permit. This can lead to poor attitude out of sheer boredom. Furthermore, it leads to memorizing rather than analyzing and reasoning, which in itself can develop undesirable characteristics. How can professors of such large classes study the attitudes of their students, much less diagnose them. Yet the time to shape many of the future habit patterns is in college where the young people are still pliable.

The professor may still say, "I can't help it, I really don't believe in mass teaching methods, but it's the policy of the school to have lots of students and large classes." This answer I would regard in the same light as that which might be given by an attractive prostitute in a large city who, if asked why she resorted to that profession rather than moving out of the crowded city to some town where she could get a respectable job, might answer, "Oh, but I didn't want to leave the glamorous big city." I'm sure this analogy will be understood by all true educators.

Many Engineers are eager to climb the ladder in industry as rapidly as possible. Then suddenly they find themselves in a high position, but frustrated beyond belief. They wonder what ails them and sometimes develop a very sour outlook on life in general. Shouldn't the professors teach them in school that rising up the ladder of success in industry is accompanied by added stress and strain, and paid for by sacrifice of more and more of self. Big money isn't paid just out of goodness of heart. You have to earn it in some way.

Temperament, constitution are often far bigger factors than intelligence or ability. By the time they graduate, students should know this and have some idea of their own limitations in this respect. Are they being educated concerning these things? If they were they might establish more realistic goals for themselves and, thus, contribute more to their profession.

I am often told by educators that, "Things aren't any worse than they ever were, so hold your horses in check." I think that's a very poor excuse. If that statement were accepted as a sound one by industry we'd still be driving Model T's rather than modern high speed cars and planes. Things must get better—much better—all the time. The *status quo ante* is not progress either in industry or education.

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A PROFESSIONAL PROGRAM FOR ADVANCED STUDY IN ENGINEERING

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Abstract—A three-year program of advanced study is suggested leading to the degree of Doctor of Engineering. A group of professional problems and a short creative problem would replace a comprehensive thesis. Class study would be more comprehensive of the breadth of engineering than present programs for Ph.D. students. The proposed program would give students interested in advanced engineering, but not necessarily in research, an alternate route to the Doctor's degree.

Advanced study in engineering normally consists either of a year or more of study to earn a master's degree or a three to four year program leading to the Ph.D. degree. Gradually, advanced study has come to the classroom stage, with the elimination of individual research problems at the master's level in many schools. There is so much advanced science and engineering to learn beyond the undergraduate program that students earning a doctorate degree which emphasizes a comprehensive research problem cannot give full attention to professional engineering experience.

In discussing advanced study with prospective students, all recognize the need for a more thorough understanding of scientific and engineering principles and their application, but many do not look forward with enthusiasm either to a lengthy laboratory investigation for their doctoral thesis or to a position in industry which consists primarily of laboratory research. These students enjoy analytical problems, design, and creative work. They would appreciate a program which equips them for assignments requiring advanced engineering training, such as design, economic evaluation, development, or technical service.

These students today may take a Ph.D. because this degree program is the only road open to them to earn a degree beyond the master's. Some may select a "paper" thesis in design procedure or theoretical developments in engineering, but this type of thesis is relatively rare.

The trend for engineers to do more desk work and less laboratory work is everywhere evident. Thirty-three years ago our engineering building had private research laboratories adjacent to the office of each faculty member for his private use. Without exception, these laboratories were converted into offices for graduate student use. Today, analytical work and calculations are becoming a larger portion of Ph.D. research. The professional engineer thinks of the desk or the drawing board as his place of business.

This presentation is not intended to disregard the need for laboratory data or the desire on the part of many students to continue in traditional Ph.D. programs with intricate laboratory research. Engineering covers a full spectrum from basic science at the one extreme to design and construction of "hardware" at the other. Pres-

ent programs of advanced study lean toward the sciences with experimental theses and cover this end of the spectrum. Engineering applications in the middle or toward the other end of this spectrum, however, require knowledge and ability equal to that for scientific investigation. Should not engineering schools prepare men for the full spectrum of industry needs, and not continue to pretend that one type of educational program can cover the full range?

A professional engineer has training and experience which qualify him to solve problems in their entirety. When given a situation requiring engineering skills, he can state the problem, solve it if sufficient information is available, and present the solution in a manner readily understood by laymen. He can investigate the economic possibilities of a new design, process, or product. An educational program which emphasizes this aspect of engineering could be a better one for those desiring advanced study but not relishing laboratory research. Let us consider the possible nature of such a program and its influence on advanced study in engineering.

The Suggested Program

The professional program suggested would consist of a nominal three years of study beyond the bachelor's degree, with two years of full class study and a group of professional problems the third year. A qualifying examination, equal to that used for selecting Ph.D. candidates, should be employed to screen students for the professional degree. An analytical solution to a relatively simple problem, requiring originality and creative effort, would conclude the degree requirements program.

Class Study should cover selected areas of engineering work based on the undergraduate background and interest of the student. It is expected that advanced class study would include derivations of familiar relationships to acquaint the student with the assumptions made. Problems to illustrate their uses and the application of engineering principles would be the main diet for the student. For those with B.S. degrees in chemical engineering, the topics of thermodynamics, rate processes, separation, and process design would be treated at an advanced level to give a thorough understanding and working knowledge of common operations. Engineering materials and process equipment design should be included.

Such work would require added courses in mathematics, differential equations, advanced calculus, and operational mathematics. Chemistry and physics beyond the undergraduate level should be mastered. Modern engineers are expected to be acquainted with rapid computing methods, statistics in the design of experiments, instrumentation, and automatic control. The professional engineer should have knowledge of such wide areas as electronics, soil mechanics, and structures. This recitation is not inclusive, but illustrates the need for selecting an area for study.

Table I gives a list of courses which the above advanced student might select. As one mentally reviews the courses now available to engineering students, it is clear that a two or three year program of class work would not exhaust the present offerings. Courses would need to be established for students in such a program to give a reasonable coverage of some areas of engineering.

TABLE I

SUGGESTED PROFESSIONAL PROGRAM FOR ADVANCED STUDY IN ENGINEERING

1st Semester		2nd Semester	
Course	Hours	Course	Hours
Thermodynamics	3	Advanced Unit Operations	4
Kinetics and Rate Processes	4	Advanced Mathematics	3
Advanced Mathematics	3	Process Design	3
Engineering Materials	3	Advanced Mechanics	3
Business Law	3	Personnel Management	3
	16		16
3rd Semester		**4th Semester**	
Advanced Fluid Mechanics	3	Process Design	3
Statistics and Design of Experiments	3	High Speed Computation	4
Advanced Physics	3	Advanced Chemistry	2
Automatic Control and Simulation	4	Nuclear Engineering	3
Electronics	3	Process Equipment Design	3
	16		15
5th Semester		**6th Semester**	
Engineering Reports	2	Professional Conduct	1
Seminar on Heat Transfer	2	Project Evaluation (4 weeks)	
Economic Study and Process Design (6 weeks)		Creative Problem (8 week allotment)	
Process and Equipment Design (6 weeks)		Final Examination	

The Qualifying Examination should survey the student's understanding of scientific principles and their applications in engineering problems. Examinations currently employed to qualify Ph.D. students would be a good place to begin, with the same standards of performance required for students in the professional program as for a Ph.D. program.

The Professional Problems in the third year would be a combination of application of engineering principles, creative engineering and communication. It is suggested that three problems currently of interest in industry be prepared by the faculty for solution with a time-limit. One creative problem should be developed and solved by the student, this without a time limit. Accompanying these individual studies, lectures on preparation of reports and on professional conduct would be in order. The student might well attend seminars to assist him in developing a suitable problem.

In our Ph.D. program, a process design and economic study is required, with a time limit of 21 days, as a preliminary examination. The student is asked to render a report as a solution to a letter problem. Presentation

of the report as well as engineering judgment are evaluated. The examination becomes a teaching process for those who do not render an acceptable solution the first time. From this experience it is believed that lectures on reporting and discussions between the student and faculty might increase the benefit to the student, at least for the first professional problem.

The kinds of problems which might conclude the program for our student are given on Tables II, III, IV and V. In addition to a process design and economic study, a process and equipment design might be required, including the drawings and specifications for materials. A project evaluation would give a sampling of the student's ability to screen the literature and evaluate engineering knowledge. In case a student has not had the experience of taking and correlating laboratory data at some time, a short laboratory problem could well be required either in the second year or as an alternate to the second or third professional problem.

Business Education required for propessional engineering might be included. The undergraduate should have had economic principles and

TABLE II

ECONOMIC STUDY AND PROCESS DESIGN PROBLEM

The Southern Chemical Company
Norfolk, Virginia

Mr. John Doe
Chemical Engineer

Dear Mr. Doe:

We have a process under consideration which requires thirty million cubic feet of natural gas per day. Our negotiations with the pipeline companies to obtain the gas are not very encouraging at this time. The price which we contemplate paying the pipelines is 38 cents per thousand cubic feet of gas should our negotiations succeed.

It has been called to my attention in a recent issue of the Oil and Gas Journal that a group in Chicago are planning to liquefy natural gas on the Gulf Coast and barge the liquid methane to Chicago. It has occurred to me that we should investigate the barging of liquefied natural gas to Norfolk.

We request that you make a study of the liquefaction of natural gas at wells located in the Gulf of Mexico off-shore Louisiana and the transportation of this gas to Norfolk. What will be the cost of gas delivered at Norfolk for well-head prices of natural gas from 10 to 20 cents per m.c.f.? What liquefaction process would you recommend for barge operation? A preliminary design for the liquefaction and the transportation barges would be helpful.

We would appreciate your report in six weeks along with your original calculations.

Very truly yours,

Lewis R. Holden
Executive Vice-President

TABLE III

PROCESS AND EQUIPMENT DESIGN

The Petro-Chemical Company
Beaumont, Texas

Mr. John Doe

Dear Mr. Doe:

We have a stream of the analysis shown below from which we desire to condense 95 per cent of the ethylene and the equilibrium amounts of heavier consttiuents. We propose to use propane refrigeration at 0° F to extract the heat. The stream is at 550 psia and 95° F, with hourly flows of 180,000 cubic feet at 60° F and 14.7 psia.

Analysis of Ethylene Gas

Constituent	Mole Per Cent
H_2	8.3
N_2	2.3
CH_4	4.5
C_2H_4	45.3
C_2H_6	20.9
C_3H_6	10.7
C_3H_8	8.0
	100.0

Please prepare design sketches and specifications for the condenser and give us a cost estimate for its construction. We require your report not later than six weeks from date.

Very truly yours,

J. H. Purdy
Chief Engineer

accounting. Personnel management, business law, patent law, and other business subjects might be selected. Such a minor program of study could offset a langauge requirement not necessary for a professional degree.

The Final Examination procedure has not been considered carefully. A review of a student's solutions to professional problems and his understanding of engineering applications could be evaluated in an oral examination. He should be required to defend his creative problem and its solution.

Effect of Professional Program on Development of Faculty

Engineering faculties should have a range of interest paralleling the spectrum of engineering. Those leaning towards the sciences would take more interest in students on Ph.D. programs, while those with experience as professional engineers would have a keen interest in the professional problems. One might expect the younger teachers to continue in research as a way of developing their ability to apply engineering principles. The professional program would provide stim-

TABLE IV

PROJECT EVALUATION

The New Era Chemical Company
Trenton, New Jersey

Mr. John Doe

Dear Mr. Doe:

We are contemplating a process which would require the use of 20,000 pounds per day of 99.+ per cent potassium metal. I have been told that potassium can be made by reacting sodium with potassium chloride and separating the potassium by distillation.

We would like you to gather the information available on the chemistry of this process. If it appears feasible, please proceed to a tentative process design for the manufacturing unit and to a report covering the necessary steps of research and development which you deem necessary before we are prepared to initiate construction of the unit. Your evaluation of the time tables and cost for the conduction of this research and development will be very helpful to our management and your technical data to our engineering staff.

May we have your report in four weeks.

Very truly yours,

Jeff Check
Executive Vice-President

TABLE V

CREATIVE ENGINEERING PROBLEM

Professor John Doe
Professional Engineering School

Dear Professor Doe:

For my creative engineering problem, I would like to study the transfer of heat between air and vertical fins on a horizontal finned tube enclosed in short chimneys.

The upward movement of air adjacent to heated vertical surfaces has been studied and reported in the literature. Likewise, heat transfer rates are known for air flowing at low velocities adjacent to surfaces. I would like to analyze the problem of heat transfer from finned tubes accompanying natural convection. The size of the fin will be held constant but the spacing of the fins and height of the chimney will be the prime variables considered.

The predictions of heat transfer made from my analysis will be compared with test results which have been made available to me by the Wolverine Tube Division on one tube in still air and with an 18 inch chimney.

Sincerely yours,

Ralph Polk
Candidate for the Degree
of Doctor of Engineering

ulating activities with students for the more experienced teachers whose extra time is devoted to professional engineering rather than academic research. Such activities should give insurance that teachers at all levels are continually renewing their ability to apply principles to new problems.

The Degree

The degree of Doctor of Engineering is suggested as appropriate for the completion of the above program. The degree of Doctor of Engineering Practice might be more descriptive but is not recommended. One can bring forward all the titles one wishes, but none have been advanced which satisfy the writer except the above.

Safeguards against a cheap doctor's degree are necessary or the new program could destroy present Ph.D. programs. The same qualifying examination is the first step. The intensive work in solving the professional problems could become as difficult for many students as the more time-consuming experimental thesis. Administration of the two programs side by side should be possible in such a way that the students would choose between them on the basis of the educational experience involved and not because of ease or degree of difficulty.

Acknowledgment. This type of program has been under serious consideration at the University of Michigan for almost two years. Discussions with colleagues at the University and throughout the profession have helped formulate the program presented.

FORMER *JOURNAL* EDITOR JOINS ARMOUR FOUNDATION

Professor Clarence E. Watson, formerly Chairman of the Department of Industrial Relations at Northwestern University, has become Assistant Director of the Armour Research Foundation of Illinois Institute of Technology. In his new position, Mr. Watson will administer research program development with industrial and government sponsors. During the past summer, "Wat" has been consultant to the Director of Armour Research Foundation, Dr. Haldon A. Leedy.

At Northwestern University, Professor Watson administered the Cooperative Program in the Technological Institute. He is an active member of the Cooperative Division of ASEE and is past Editor of the JOURNAL OF ENGINEERING EDUCATION. Mr. Watson has served as Special Assistant to the Secretary of Defense, Charles E. Wilson. He has also been consultant to the General Electric Company and to the Standard Oil Company (Indiana).

COMMUNICATIONS

J. STUART JOHNSON

Head, School of Electrical Engineering, Purdue University
Lafayette, Indiana

A talk given before the Joint Dinner Meeting of the English Division and Humanistic-Social Division of ASEE, June 25, 1956

It is a distinct honor to be asked by your Program Committee to talk to you for a while this evening on a subject which is of tremendous interest and vital importance and concern to all of us responsible for the education of engineering students.

I have selected the area of Communications as the subject of this discussion partially because of the images which it raises in the minds of engineers and English professors alike and with the hope that I can induce similar images in the minds of those of you who teach Humanities and Social Studies. I have selected this topic also because I am convinced that it is through communications, or perhaps I should say because of a weakness or failure in our communication system, that we have not progressed further toward the solution of our common problems.

Industry has spoken loudly and at considerable length on the lack of English proficiency, the limited acquaintance with the humanities, and the need for more training in human relations for engineering graduates. You, here this evening, and your colleagues are to be lauded and commended on your active interest in this phase of an engineer's education. Your membership and participation in the work of an engineering organization speak for your devotion to your own educational discipline and, furthermore, attest to your determination to assist the technical educator in producing the most effective engineering graduate possible.

I, too, insofar as my abilities and appreciations are concerned, am what some of you, and not always facetiously, refer to as an uncultured engineer. I will neither refute nor accept at the moment this portrayal of an engineer. However, perhaps as we progress in this discussion, some of the reasons for the existence of this impression and some of the ways in which it might be corrected in the future may emerge.

There are three stages to the communicating process. The first of these involves the transmission of the message. From the engineer's point of view this might be likened to the broadcasting station, the television studio, or the telephone office. However, whereas the engineer's fundamental interest lies in the technical details associated with the design and construction and operation of these services, the English and speech expert is concerned with the formulation and oral or written presentation of the material to be transmitted.

The second stage of communicating concerns the receptivity of the listener. Here again the engineer and the English instructor have similar but divergent primary interests. Whereas the engineer is concerned with the technical aspects of the radio receiver, the television set, or the telephone in-

strument, the English instructor thinks in terms of the attitude of the listener or reviewer. I know that you, as I, have many times sat in front of our radios or television sets listening to an address on one subject or another and have attended to the message with only a small portion of our minds. We have not been receptive; we have not even been attentive; and as a result we have not really heard what the speaker was trying to say.

A third stage of the communicating process might be called decoding. Here the engineering parallel may be somewhat more farfetched. You have all heard, I am sure, of scrambled speech whereby the words spoken into the microphone at one end of the radio link are, through various electronic means, mixed up in such a way that anyone intercepting that message with a standard receiver would hear nothing but a series of garbled syllables. It requires a special receiver uniquely equipped to unscramble these syllables and re-arrange them to make the message intelligible. You have all listened to short-wave broadcasts in Morse code and the majority of you have not been able to interpret the message. Or you have tried to listen to your radio with a thunderstorm going on outside and found the static so heavy that the program was unintelligible. For correction in each of these instances there must be a filtering out of surplus noise, a proper interpretation of the signals received, and in general, the transmitted message must be subjected to a de-coding process.

A similar condition exists in the mind of a person on the receiving end of any communication. The one delivering the address may be expounding his philosophies and ideas in the most acceptable manner, the person listening to the address may be in the most attentive and receptive mood possible, and yet because of his own background or because of the innocent injection of a simple phrase the listener may have his thoughts reoriented in the light of certain of his own experiences and may very well completely miss the point of the address or misinterpret it entirely.

The primary interests of those here this evening, insofar as engineering education is concerned, are, because of your separate areas, somewhat different, and yet basically are quite similar. Each of you experiences a need to present your material properly to a student receptive to your message and one conditioned to interpret the subject matter correctly from your point of view.

Let us consider the problems of the English instructor first. Engineers are not, in the majority, basically incapable of proper expression, either orally or in written form. I have had an opportunity to be associated with several corrective programs in English and have discovered that engineering students who are not required to speak or write correctly in their everyday work frequently, and possibly more often than not, do not do so. On the other hand, if these same students are placed in a position where they are aware that the material they are writing or the talk they are giving is being examined for its correctness and its intelligibility, they will, in ninety per cent of the cases, perform quite adequately. The remaining ten per cent does not represent a disgraceful or significant number of deficient persons.

I am not, therefore, overly concerned, actually, with this ten per

cent. I am extremely concerned, on the other hand, with those who can perform but do not. The fault is with you as English teachers and with me and my colleagues as Engineering teachers. However, I feel it only proper and quite just to place a substantial portion of the blame on you for this latter phase as well.

You have, in your teaching of English, in general done a very adequate job in preparing and presenting your material to the student. You have organized it well; you have presented it in a logical manner; you have drilled the student on the important phases of the subject; and when you have examined him on it, he has by his performance indicated a satisfactory or reasonable, though not perfect of course, grasp of the material and its use.

What you have not been able to do is to prepare him as a receptive listener. He has merely absorbed the mechanics of your instruction to a great extent because he was required to take the course. In order to be of lasting benefit and actually to increase the immediate effectiveness of your instruction you must condition the student's mind. One effective way is to impress on him the importance of language as an essential and indispensable tool in his own profession.

Similar parallels can be established with reference to the other two tools an engineer uses, or one might even say the other two languages an engineer uses, namely, engineering drawing and mathematics. For it is through all three of these media and by means of all three of these languages that the engineer communicates. While he is generally aware of the need for some degree of skill and proficiency in the latter two, he frequently fails to appreciate the importance of the first as it will affect his professional development.

I feel, that the first step in improving your English instruction to the engineering student is to be certain that he knows and recognizes even to the extent of acknowledging the fact that proper command of English is essential in the presentation of his ideas to his supervisor, and that later as a supervisor it is just as essential in the interpretation of the expressed ideas of his employees and that this ability is as important as technical competence.

I suggested, too, that one of the reasons for poor performance on the part of the majority of our engineering students is the engineering instructor himself. I think it is obvious why I have indicated that the fault here, too, could be traced back to the English instructor. The engineering teacher himself is one of your products. Perhaps he was not made properly aware of the importance of this engineering tool during his college days.

I recall an incident that occurred during my first years of teaching. Although the incident occurred some 20 years ago, I consider it as extremely significant as it applies to this situation. As a young idealistic instructor, and one who had been raised in a surrounding which demanded reasonably accurate usage of English, I was quite sensitive to any departure on the part of my students in matters of sentence structure, spelling, and general organization in their laboratory reports. I was quite liberal in my use of the red pencil in grading. The students' apparent serious lack of ability in this direction disturbed me greatly. As a result, I decided to take the problem to one of the senior

members of the department. I discussed the matter at some length with him and he, knowing my family background, made a statement which I feel is a classic example. It was simply this "Yes, it is a problem, but it don't bother me as much as it does you." Since that time I have observed similar deficiencies on the part of a significant group of other instructors.

I would like to describe another incident which may be pertinent to the issue. It certainly points up the matter of carelessness. Some years ago I received a short letter from an organization which I shall identify only as one concerned solely with the improvement of English. As I recall it, the letter, including the address of the sender, the salutation, and the body of the letter, covered only nine typewritten lines. However, in this short communication there were seven errors in spelling, punctuation, grammar, and form. I am sure, considering the origin of the letter, that the writer knew better but merely became careless, with the resultant effect.

The biggest criticism which industrialists make of the engineering graduate today concerns his inability to communicate properly and to express his ideas in brief and concise, understandable terms. To employ an engineer who lacks this ability is certainly to employ a handicapped individual. A man may be extremely competent technically, but if he is unable to disseminate his knowledge, his worth to the company and to society falls short of what it could be.

You and we, both as English and Engineering teachers, have a real duty to perform. We must make a concentrated effort to reduce and ultimately eliminate the situation which permits this criticism of our engineering graduates to exist. It can be done.

It will require awareness on your part of the need properly to stimulate the student and to develop in him a realization of the importance of this phase of his training. To do this, you must add to your present method a program of student conditioning such that the student becomes receptive to your message. You must at the same time also properly orient him so that he correctly interprets the message which you are trying to transmit.

You must also consider the possibility of introducing a supplementary program whereby you insist that continued use of the English language in the proper form be required by instructors in the other disciplines. Mathematics, the traditional tool of the engineer, is no more important, but would, if continued proper usage were not insisted upon by the engineering teacher, become just as much an invitation to criticism. I strongly recommend, therefore, that you consider a type of engineering teacher conditioning as a necessary part of your English instructional program.

And now let us turn to the subject of Humanities and the Social Studies. Here, too, we face the problem of communications in all its various aspects. There has been a tremendous volume of written and spoken matter on the subject of liberalizing the engineer. The Engineer's Council for Professional Development some years ago recommended that approximately twenty per cent of the engineering curriculum be held for such subjects.

The magic number of just twenty per cent I feel has no real meaning, however, unless one is prepared to say that the concentration of some twenty-five to thirty semester credit

hours of work in this area is the exact amount necessary to give the student the proper understanding and appreciation of the area concerned and to produce in him a desire and interest to continue further self studies along these lines.

Here, again, the problem of communication is acute. Again the material has generally been well organized and well presented, but probably even less than in the case of English courses is the student's mind properly receptive to the material. If it happens to be a course in poetry that the student is studying, he may hear you read the poem and he may follow your instructions and memorize the poem, but all the talking in the world will not make him, or perhaps I should say show him, how to read into this poem the beauty, the meaning, and the philosophy which the poet was trying to express. His de-coding process is not functioning correctly. And if it were, in many instances his receptivity is so poor that the de-coder never gets a chance to operate. He is so completely enthralled by the thought of the wonderful engineering feats he will one day accomplish, that in his relative immaturity he sees no earthly need for studying these so-designated non-technical courses. It happens even within the technical courses; therefore, it is only normal to expect this attitude even more strongly in less closely related subjects.

I have used the illustration of poetry. I might just as well have mentioned history, psychology, music, art, philosophy, or any one of a number of other areas which we include under the general heading of Humanities and Social Studies.

Here as before, however, the fault is not yours alone. Although again, indirectly, perhaps you are to blame. All too frequently the engineering instructor himself lacks the appreciation which he should have for these various subjects. In this sense, therefore, the fault may reflect back to your instruction of the earlier generation.

The age-old and trite expression, "You can lead a horse to water, but you can't make him drink" most certainly applies in this instance. We can require twenty or two hundred semester credit hours of work in the areas under consideration and still if the student is not stimulated and conditioned, he will take the courses because they are required and he will devote the minimum of time to these courses necessary to receive the grade which he, according to his general over-all abilities and standards, considers respectable. Once through the course, he will never take the time or develop the interest to further his acquaintanceship by self-study.

And fundamentally is not this our prime function in any educational system? One cannot teach a student. It is possible only to help him want to learn more about a subject and to show him how he can extend his knowledge by self-learning processes. Even considering the primary and secondary schools, educators have these students a scant sixteen years. They have three times as many more years to live before they reach the allotted three score and ten.

There is little you can do to set right the de-coding mechanism in a student's mind, but you can at least give it an opportunity to function. Your responsibility in the instruction of engineering students, therefore, is primarily that of putting the student in a receptive mood. This can best be done not by giving him more

courses in a subject, but instead by concentrating in the one or two courses in which he may register a particular realization of the place of this particular subject in his own life and more specifically the manner in which it relates to his own profession. He is sold on his professional goal and generally will extend himself to acquire knowledge related to it. The same can not be said for courses he feels are not so related.

If you are responsible for preparing a course in history, for example, to be given to engineering students you would do well to abandon immediately the idea of designing a course which would be the same as or similar to the beginning course for students majoring in the field of history. The objectives for the two groups are entirely different. Rather you should design a course which will stimulate the student by relating history to his major interest or profession. If he is shown the impact of history on the growth and development of his profession, or if, in conjunction with his readings on historical events, he discovers that many of the persons who "made" history, as we might say, also made material contributions to the engineering profession, you will have caught his imagination and, upon completing the course, it is highly probable that he will not only have learned what you wished to teach him insofar as the immediate course is concerned, but curiosity, which is a fundamental requirement of a good engineering mind, will lead him to delve further into the common aspects of the subject.

If your responsibility is teaching the subject of government to these students, you might apply a similar psychology. Certainly the organization and structure and actions of governmental bodies are of extreme importance and will probably be of even more importance in the future in their relation to the engineering profession. The teaching of art, literature, and music can be approached in much the same manner. Music, for example, is an assembly of sounds which are nothing more than waves of different frequencies and it may well be that the attention of the student can be caught by injecting into such a course some discussion of the scientific theory of the production of these sounds.

It should be the further responsibility of the engineering instructor to continue relating the engineering profession to the humanistic and social aspects of life in the engineering courses themselves. For example, psychology and ethics, human relations and such subjects can well be incorporated into engineering courses even if only by example. Here again, however, as in the case of English instruction, you may be faced with a job of engineering teacher education.

I feel compelled to inject one more thought into this discussion. I hope it will not be, as might well be the case, considered as presented solely either in defense of the engineer or as a criticism of the liberal arts graduate. I believe, however, it is pertinent to our previous discussion of communications in general. You state, and we admit, that the engineer would be a better professional man and citizen by virtue of having more acquaintance with the arts, for example. It is equally true that the education of the liberal arts student is not complete when one considers that we live today in a technological world if in the course of this education the student has not acquired some knowledge

of and appreciation for fundamental technology.

Here again we have a matter of communications. Perhaps were the liberal arts graduate more versed in the implications of technology, he might recognize that the engineer is an artist.

For example, have you ever seen anything more graceful than a well designed suspension bridge, or have you ever noticed the artistic lines of the substation transformers you pass during a drive along the highway? Or, have you ever had occasion to listen to engineers representing company management in discussion with union representatives? This is certainly a problem in human relations. Have you not known engineers who sit on school boards? I think that you will find that the engineer in general is aware of the problems of his country and its people, aware of his responsibilities, and aware of the fine arts to a greater degree than many liberal arts graduates are aware of the implications of automation, for example, and other industrial activities which are so essential to our present day standard of living.

I suggest, therefore, that you give serious consideration, while you are designing an educational system which will help the engineer to become a better citizen, to mending your own fences and doing similarly with your own graduates.

This is not to be taken in any way as an attempt on my part to disclaim any need on the part of the engineer for betterment, but I feel that by the introduction of more technology into your liberal arts programs, a more common ground for understanding could be reached and our inter-communications would be facilitated and their effectiveness improved.

It has been my purpose this evening merely to think with you about some of our mutual needs and to suggest ways in which we might satisfy them. I believe that if we make a firm effort to study the three stages of communications, transmission, reception, and de-coding, and apply the results of this study to our recognized problems, we will find that we have taken a great stride toward their solution. For I believe firmly that the large majority of this world's problems, our own included, can be solved or greatly reduced in magnitude by proper understanding which in turn can only be obtained through effective communications.

Joseph B. Hershman, President of the Valparaiso Technical Institute, Valparaiso, Indiana, died in an automobile accident while returning from Ames, Iowa, after the 1956 ASEE Annual Meeting. A member of the Society since 1943, President Hershman was the immediate past-president of the National Council of Technical Schools and a member of ASEE Technical Institute Division's National Committee.

ECPD AND EJC RELATIONSHIPS

Report of the ECPD Planning Committee

At the 24th Annual Meeting of Engineers' Council for Professional Development its Planning Committee submitted the report quoted below. It was *voted* that the Planning Committee be instructed to study, in cooperation with the Planning Committee of EJC, the problem of developing a plan for an eventual affiliation or combination of ECPD and EJC.

"An eventual combination of EJC and ECPD is important for the following reasons:

1. The objectives of the two organizations are in a broad sense much the same.

2. There is much confusion in the minds of engineers generally and the governing boards of the constituent societies of both groups particularly, concerning the difference between the organizations and the reasons for having two such groups in the engineering field.

3. Many societies are members of both EJC and ECPD. These societies are confronted with two budgets and two appropriations which look to the Boards of these Societies to be devoted to the same ends. This apparent duplication jeopardizes the financial support and stability of both organizations.

4. Some overlapping exists in the activities of ECPD and EJC. Several joint committees are in being and at times it is difficult to decide which organization should handle a specific situation.

5. ECPD has evolved in a definite functional pattern. It guides the young engineer from high school into an engineering college, follows him through college, and guides him through the first few years after graduation until he is ready to become a licensed engineer or is eligible to join an engineering society as a full member. ECPD advises engineering colleges and accredits their curricula. These ECPD functions can readily be discharged in a combined organization. It has not been found necessary nor desirable to expand the activities of ECPD beyond this area.

6. EJC activities are more general. They cover the rest of the engineering field not occupied by ECPD. EJC is tending to operate through the functional organizations such as the Manpower Commission to which are assigned large areas of engineering activity. These functional groups have their own offices, staff, committees, and procedures which are authorized by EJC."

THE TECHNICAL MANPOWER SITUATION

DR. ALBERT WATSON DAVISON

Consultant, Owens-Corning Fiberglas Corporation
Newark, Ohio

An address given at the Annual Dinner of the Chemical Engineering Division, June 25, 1956

In recent months we have heard and read a great deal about the shortage of engineers in America, without hearing much about an equally important subject—the shortage of scientists. And yet this latter problem is every bit as acute as the former. Science and engineering are intimately and inalienably related to each other. We, as Chemical Engineers are aware of this situation, for our profession is but recently divorced from the science which gave it birth; and we know that the better the scientist, the more competent the engineer.

Many of us believe for the future that the greatest threat to the education of competent, high class engineers comes from the anticipated shortage of truly top-flight science teachers of mathematics, physics, and chemistry needed to give them the proper scientific background on which to build their technical competences. And one of the great dangers for our industrial economy and our national preparedness lies in this shortage of scientists. America has been producing neither an adequate number of high-grade engineers, nor a sufficient number of scientists of high competence—technologists all, and it behooves us as leaders in our profession to stop talking about the need for engineers in America and to start talking about the need for competent *technologists*, and to do everything within our power to see to it that young men, and young women, too, of ability are encouraged to prepare themselves for the particular phase of technological endeavor for which they are peculiarly qualified.

Now it is not my purpose to burden you with statistics this evening. You are fully as aware as I that the production of technologists in America has not kept pace with the normal peacetime demands of a growing population and an ever-expanding technological civilization; you know that our potential enemy, Soviet Russia, surpassed us in 1953 in numbers of engineers graduated; that they are way ahead of us in training scientists; and that unless we do something about it—and do it promptly—in 1965 they will have more technologists at work than we will, and will be energetically carrying out their long-cherished ambition, of exporting technologists and leaders to the backward Asiatic and African countries, in the expectancy of capturing their teeming millions, not by the rifle and bomb, but by the slide rule and the logarithm table and the T square!

What you do not know, and may not even suspect, is the alarming fact that the education of scientists and engineers of the highest competence has fallen off in America even faster than has the number of technologists graduated. And this has happened when America's need for men of this type was never as great, either to sup-

port the national economy, or to strengthen us against our potential enemy!

Now fortunately, the development of the strong technical graduate which America so badly needs is something which you as members of the American Society for Engineering Education can do something about. And you can do it in a number of ways. Perhaps the most promising and fruitful lie in the fields of curricular revision, and the re-adjustment of the student's working hours. I am convinced that our engineering leaders of the next generation will be men who have read widely and mastered completely the three sciences on which all engineering is based, who also understand the sister sciences, biology and geology, and who are completely competent in such *engineering* subjects as thermodynamics, strengths and properties of materials, and fluid mechanics. They probably will never have heard of such "tool courses" as stereotomy (stone cutting, to you uninitiated), sulfuric acid manufacture, the Le Blanc soda process, and other so-called "practical" courses, which were five years obsolete when they were being taught!

I believe the trend in the education of engineers of the highest competence in the future will be toward the development of a basic course in general engineering, on which the student may build for post-graduate specialization, or on which an employee can build for successful advancement in his business.

I believe too, that the engineering college which is more concerned in graduating quality than quantity will provide for proper distribution of student time between classroom contact, laboratory exercises, study, recreation, above all, for reflection! I have little patience with those institutions which tie up their students more than thirty hours per week in classroom and laboratory, give them heavy academic assignments, and expect them to become the Great Engineers. And I believe that the Engineering College which will be the leader in its field in the future will substitute more courses in the humanities, in oral and written communications, in public relations, in psychology and in economics, for the practical, industrial, "tool courses" now being offered. It may take five years for a student to complete such a course, but the student can well afford to spend the time, and America can well afford to subsidize him, in order to turn out the type of super-engineer I am talking about tonight!

These things I hold to be necessary for the education of the kind of engineer and scientist America will need, if she is to hold her present position of technological world dominance:

a. Drastic curricular revision.

b. A complete overhauling of the budgeting of students' time.

c. More inspiring teachers.

d. A classification of aspiring students of technology into at least three groups:

1. The super technologist—the type of man we have been talking about. A man with an "AGCT" or an "IQ" of 120 or over. (Army general comprehension test; intelligence quotient.)
2. The ordinary chap, 100 to 120, who has competence in some directions—but who also has limitations which will prevent him from ever becoming a real leader.
3. The technician. There are many men of this type in America.

They are badly needed, and there is a definite training program required for them. Fortunately it is just getting under way, through technological institutes designed for training engineering (and scientific) aids. You will hear a great deal about them in the future. America has neglected to furnish her engineers and scientists with "hands and feet" to implement their professional activities, and on this account, may technologists are not being utilized at their maximum abilities. Russia has shown us the way in the training and utilization of engineering and scientific aids; she *had* to—and we better learn promptly!

Turning again to consideration of the education of the superior type of technologist, America is fortunate in possessing an adequate supply of properly qualified young people. Data collected by the Armed Forces indicates that slightly over 1,800,000 young men attain the age of 18 each year, and the number is growing. And about the same number of girls reach 18, but we will forget about the girls for the time being, for their normal early careers will be in the areas of child rearing and home making. Many of them may come into the teaching or industrial picture later on in life, but let us accept their contributions to the manpower problem at that time as a bonus, rather than as a bankable asset.

Of the 1,800,000 boys, seventeen per cent have been found to possess AGCT ratings of 120 or above. This furnishes us 306,000 young men each year, from which must come the leaders of the future—engineers, scientists, doctors, dentists, lawyers, statesmen, generals, admirals, teachers, authors, business and labor leaders, theologians —leaders in every profession and in every walk of life.

Now out of these 306,000 young men, only 50 per cent of them will today enter an institution of higher learning, and not more than 50 per cent of these will graduate; which leaves us with a little over 75,000 educated men of highest mental ability in all fields, out of a potential of 306,000! Out of each four highly qualified young men who receive diplomas from our academies and high schools, three are lost because of inadequate secondary school preparation, insufficient financial resources, lack of motivation, indifferent attitudes on the part of parents, friends and guidance councilors. If we could find some means of motivating only *one* of the three high-grade lost sheep to undertake a career in science or engineering, our technical manpower problem would be solved in less than ten years.

I am happy to be able to report progress in achieving this goal. For the past six years a sub-committee of the Research Committee of the National Association of Manufacturers has enlisted the public and industry to support the secondary school systems of America. They have emphasized the need for substantial people to "stand" for school boards in their home towns; and for contributing to the improvement of the economic and social status of teachers. The National Association of Manufacturers has also issued thousands of copies of various booklets on the support of school systems, on careers in science and engineering, and on allied subjects. These have had excellent acceptance among industrialists, and

with guidance counselors in the schools. The Scientific Manpower Commission and Engineering Manpower Commission of Engineers Joint Council have striven continuously in their respective fields (and often by joint action) to call attention to our need for more and better technologists, and to inspire their member societies to actively engage in programs for reaching adolescents through their members, in order to supply the motivation needed at the formative age.

During past years a number of Manpower Conferences have been held in Pittsburgh, Washington, D. C., Chicago, New York, and West Orange, New Jersey, which have brought together leaders in business, the colleges, secondary schools, engineering and scientific societies, members of state boards of education, government and the Armed Forces, to analyze our manpower resources and requirements, and to initiate programs for their implementation. The Congress has become interested, and has been conducting a joint investigation into the problem, looking toward possible legislation. And lastly, the President of the United States, also concerned, has set up "the President's National Committee for the Development of Scientists and Engineers." This Committee is headed by Dr. Howard Bevis, lately President of the Ohio State University, and is composed of presidents and leaders of national industrial, educational, scientific, engineering, political and labor bodies. Although the President's Committee is just getting under way, real contributions to the solution of the scientific and engineering manpower problems are expected from it.

Despite the excellent results which are accruing from the various activities I have just described, there still remain at least two additional goals to be attained. The first is concerned with the economic and social status of technologists. Although they are professional men, with anywhere from four to seven years of hard, arduous and expensive study behind them, many of our citizens regard them as merely hired hands who perform their daily functions, specialized as they may be, for wages alone, the same as a day laborer! They do not realize that technologists are members of the great middle class which made America what it is today, and who as members of the middle class are suffering from the economic squeeze which has resulted from the political manipulations engineered a quarter of a century ago by politicians whose chief ambition was to reduce all Americans to a common denominator.

The social and economic status of the technologist cannot be restored until all Americans appreciate and recognize the contributions he has made to our economy; until the technologist raises his own head above the level he has been content to occupy, and performs a little better job of selling himself, his profession, and his accomplishments to management and to his fellow Americans; and until management more fully recognizes its need for the type of services he is prepared to offer.

There are now a number of indications that business is becoming fully aware of its dependence on technology for its growth and success. One of these is its concern over an adequate supply of trained men for the future, and another is the mad scramble for technologists which takes place on every campus each spring. The

constant increase of initial salaries is another straw in the wind. And as our technical situation becomes tighter during the next ten years, the law of supply and demand cannot help but enhance the economic status of older, more mature employees—at least of the more capable among them!

The second question which needs to be given careful consideration involves the obvious hoarding and misuse of technical manpower both within the Armed Forces, and in industry. With a better understanding of what Russia has accomplished from a technical standpoint, and the strides she has made in the training of scientists and engineers, the Armed Forces, and Selective Service have seen the light, and are no longer conscripting engineers and scientists and forcing them to devote two years of their professional lives to military duties. While admittedly, there are still a few blind spots in the Services, the situation is generally good. But in industry, there is unmistakable evidence of the hoarding of technologists, and of the utilization of engineers and scientists at skills beneath their abilities. Manpower hoarding is largely practiced by industries which are operating under governmental cost plus contracts. These industries are partly responsible for the fantastic initial salaries offered graduating engineers.

And the majority of well-managed corporations are prostituting the abilities of even their best engineers, by compelling them to perform non-engineering duties in connection with their jobs which could be better performed by clerks and secretaries. One large corporation found that it could reduce its engineering staff fifteen per cent, get more work done by happier engineers, and pay them better, by relieving them of non-technical duties. The simple expedient of hiring a few more clerks, secretaries, and engineering aids did the trick!

In closing, I would like to leave the thought with you that the technical manpower situation is still in a very confused state, despite all the work which has been done to improve it. We recognize that we are dealing with a long-term problem, and that to solve it, we have an education program of considerable magnitude to perform—not in the education of the scientists and engineers themselves, but in the education of the people at the grass roots—in order to induce them to strengthen and support their secondary school systems, to provide wise counciling for their children way down in the grades, when they are at the formative age, and to see to it that worthy students are motivated and have the opportunity to attend an institution of higher education.

We need engineers, and we need scientists, we need doctors, statesmen, teachers—trained men of every classification. And there is no danger of educating too many high grade men—for remember, only seventeen per cent of our boys and girls have AGCT ratings of 120 or over, and we cannot afford to permit any one of these to waste his talents by exercising them at a lower level than his ability will permit.

THERMODYNAMICS AND ENGINEERING

To preserve the benefits of the conference on thermodynamics sponsored last year by the National Science Foundation and the ASEE, eleven of the major technical papers have been printed and made available under the title *Thermodynamics and Engineering*. Published with the support of the NSF, the new volume was prepared by the Department of Engineering Research in The Pennsylvania State University, where the conference was held.

Contents of the volume fall into three areas: science, industry, and education. Science contributed seven papers, including ones on irreversible processes, statistical thermodynamics, relaxation phenomena, electrochemistry, electric and magnetic systems, and elastomer thermodynamics. Industry added three papers on heat engines, distillation calculations, and chemical rate processes. The educational aspect concerned thermodynamics as an engineering science in the curricula of the future.

Until the supply is exhausted, engineering teachers, research workers, and libraries may obtain copies of the 194-page, spiral-bound volume without charge by writing to the editor, Dr. W. E. Ranz, Department of Engineering Research, The Pennsylvania State University, University Park.

"SISTER UNIVERSITY" CONTRACTS (From Page 198)

investigation of any of its activities by proper authorities at any time. This requirement has made it necessary to impose restrictions on the conduct of operations under "sister university" contracts to which university professors and administrators have not been accustomed. For example, any professor going to a "sister-university" abroad must have security clearance before his salary can be paid from government funds. University representatives believed that they had been bound too closely to particulars up to the time of the Michigan State gathering, due perhaps to the checks and balances inherent in our governmental structure. Nevertheless there was general agreement on keeping the sights of the "sister-university" program high, and not allowing day-to-day problems to obscure the "great idea" of this world-service enterprise.

It will be of interest to hear from our speakers this afternoon whether, in *their* experiences, they have had occasion to feel as so many of the group meeting last November did, that here is a foreign assistance program that they can believe in and are willing to participate in, in spite of the difficulties that now exist, hoping always that they may be ameliorated in the future.

ENROLLMENT TRENDS IN CIVIL ENGINEERING

CHARLES N. GAYLORD

Chairman, Civil Engineering Department
University of Virginia, Charlottesville

Report of a sub-committee of Committee 1 of the Civil Engineering Division. The sub-committee was appointed by Professor A. J. McGaw in January 1956. Members are Prof. R. C. Bunker, Dean L. K. Downing, and Prof. C. N. Gaylord, Chairman.

Engineering enrollment in the 217 institutions which confer engineering degrees has increased for the fourth consecutive year. 13.5 per cent more engineering students enrolled at all levels in 1955 than in 1954, compared with an increase of 11.4 per cent in the total male enrollment for all higher educational institutions. The increase in engineering freshman enrollment was 11.2 per cent compared with an increase of 8.7 per cent in total male first-time enrollment. For the three years before 1955, however, the enrollment of engineering freshmen had increased at a declining rate. The increase in 1955 was larger than that in 1954, but smaller than that in 1953 and 1952.

An increasing proportion of our undergraduate students are enrolled in electrical, mechanical, and civil engineering, the percentage being 56.7 in 1955 compared to 54.5 in 1954 and 54.0 in 1953. During this period, however, civil engineering enrollment declined from 13.3 per cent in 1953 to 12.3 per cent in 1954, and 11.9 per cent in 1955. Electrical and mechanical, by contrast, have each *increased*, and in 1955, 23.3 per cent of the undergraduates were enrolled in electrical and 21.4 per cent in mechanical engineering curricula.

A study of enrollment figures from 1952 to 1956 indicates that a larger percentage of the unclassified freshmen register in Electrical Engineering than in Civil or Mechanical. In fact, Civil shows a decrease in enrollment between the freshman and sophomore years, except this year (1955–1956), in which we had a slight increase. It is apparent, therefore, that orientation courses presented in the freshman year are not causing many undecided students to study civil engineering.

A questionnaire was sent to each of the 136 schools which have a civil engineering curriculum accredited by ECPD, and 95 replies were received. Of the schools replying, 53 indicated a percentage decrease in civil enrollment, 33 no appreciable change, and eight a percentage increase. Several schools reported that their enrollment is already as large as their staff and facilities can accommodate, and that additional enrollment will mean quantity at the expense of quality. Some of these schools have tightened their admission requirements in order not to sacrifice quality of instruction because of large enrollments.

Some of the reasons for the decline of enrollment in civil engineering are:

(1) To many high school students, civil engineering implies surveying; they are not made aware of the scope as well as the glamour and adventure associated with civil engineering. The public is also ignorant of the im-

portance of civil engineering in providing for their health, safety, comfort, and convenience.

(2) Many high school guidance counselors believe that civil engineers work either for the local, state or Federal government (at lower salaries) or in construction. These counselors have been deluged with publicity by the aeronautical and electronics industries concerning the high salaries and the glamour of supersonic flight and guided missiles.

Full page advertisements in popular magazines give the impression that the only demand for engineers is in these fields. Even our own *Civil Engineering* carries full page ads titled "Destinations Unlimited," "Wanted! Engineers to Help Make Long Range Missile History."

(3) Starting salaries are lower for civil engineers than for those in other branches of engineering. Graduates are not anxious to sacrifice salary for security with governmental agencies.

Although some schools view with alarm the decrease in civil enrollment, others believe it to be a blessing. In the opinion of many, interest in civil engineering will increase when starting salaries as well as salaries ten years after graduation are attractive. Evidently the demand for civil graduates is not sufficiently great to warrant salaries comparable with those received by other engineers.

From many of the questionnaires it is apparent that the decrease in enrollment is not as critical as the quality of the applicants for admission to civil engineering in comparison with those who apply for the other branches. One school reported that only 76 per cent of the civil engineering applicants became candidates on a basis of entrance examinations compared to 85, 84, and 84 per cent for electrical, mechanical, and chemical, respectively. Therefore we as educators should be more concerned with interesting the *better* students in civil engineering rather than attempting to find means of increasing our enrollment percentage-wise.

Two entirely different views were expressed as means of interesting the better students. One is to strengthen the curriculum in its scientific and technical content. The belief is that tomorrow's student will compare the civil program to the other courses of study and make his selection on the basis of the program which will give him the best fundamental education.

The other group believes that the civil engineer should receive more training in the humanities, in government, economics and management, rather than more mathematics and physics. Some of this group are of the opinion that the increased emphasis on mathematics and science in the other branches will force a decline in their enrollments.

It is difficult to draw any conclusions which can be presented as recommendations of this committee. Perhaps the best solution is to let nature take its course and hope that a severe shortage of civil engineers will raise the status of the civil engineering profession and bring about an increase in salaries and therefore increased enrollment.

The only specific recommendation that the committee can make at this time is that the Civil Engineering Division of ASEE propose that either ASCE or AGC seriously consider the production of a film depicting the interesting work performed by the Civil Engineer.

MINUTES OF THE EXECUTIVE BOARD MEETING

Chicago, Illinois, September 15, 1956

A meeting of the Executive Board of the American Society for Engineering Education was held in the Illini Center of the LaSalle Hotel, Chicago, Illinois, on September 15, 1956. Those present were W. L. Everitt, President; W. T. Alexander, C. A. Brown, F. C. Lindvall, and R. J. Woodrow, Vice Presidents; John Gammell, Treasurer; W. Leighton Collins, Secretary; E. C. McClintock was present as Editor of the JOURNAL. Dr. P. N. Powers was invited to present the report of the Atomic Energy Education Committee. President W. L. Everitt was chairman.

1. *Correction to minutes of June 1956 meeting.* The Executive Board *VOTED* approval of the following two corrections:

a. Item 14d should read 200th anniversary instead of 100th.

b. Appendix C, Record of Bonds, should have the Jan. 1943 issue totalling $7,500 deleted; they matured and were cashed. The Total Bonds should be changed from $46,700 to $39,200, the Total of Cash and Securities should be changed from $146,083.87 to $138,583.87, and the Net Worth of the Society from $87,689.49 to $80,-189.49.

2. *Society funds.*

a. *Opinion on unrelated trade or business.* The Secretary reported that after conferring with the Auditor regarding the federal laws pertaining to unrelated trade or business of non-profit corporations, as directed in the Minutes of the Executive Board dated June 24 and 27, 1956, it was concluded that ASEE need not be greatly concerned about the publication of the JOURNAL OF ENGINEERING EDUCATION being considered an unrelated trade or business activity. The factors on which the conclusion was based are detailed in a letter from the Secretary to the Executive Board dated August 14, 1956.

b. *Investments.* After discussing various types of investments the Executive Board *VOTED* that the Secretary and Treasurer be authorized to invest funds of the Society not needed for current operations in such amounts that the balance in the checking account does not fall below $15,000 at the time of making such investments and that the investments be limited to accounts in savings and cooperative banks (insured by FDIC) and long or short-term government issues such as bonds and treasury notes.

3. *Division and Committee Budgets.* A complete report for the year 1956–57 is not yet available.

4. *Annual Meetings.*

a. *Registration fee.* The Executive Board endorsed the opinion of the Secretary, letter to the Executive Board dated July 26, 1956, that at the present time the $4.00 registration fee for the Annual Meeting was adequate, that expensive souvenirs for those attending should not be purchased, and that soliciting industries for prizes

(unless it is an established large-scale plan of an industry) should not be encouraged.

b. *Theme.* It was agreed that to be effective a theme for an Annual Meeting needed to arise spontaneously and that if such was not the case there should be no concern.

c. *Awards.* After a discussion of Divisional and Society awards it was agreed to defer action until certain changes in the constitution were studied.

d. *1958 Meeting.* It was agreed that the Society has no interest in the promotion of post-convention trips and that decisions about scheduling such supplementary tours should be up to the local committee.

e. *Annual Banquet Speaker.* It was agreed that the Secretary should inform Cornell University that the Executive Board believes it is satisfactory to select an outstanding local speaker known for his ability to give an informative and interesting talk, and that a non-technical subject even might be preferred.

f. *Joint Meeting of Educational Methods Division and ECAC.* The Executive Board reaffirmed its stand that no programs are to conflict with the General Sessions on Tuesday, Wednesday, and Thursday mornings. Any Division can coordinate its program with ECAC, or other groups, but there will be no simultaneous sessions.

g. *Geographic Distribution of Annual Meetings.* The Executive Board agreed that the periodic meetings in the far-west and in the south or southeast every eight years should be interpreted liberally as a general policy and that special occasions of institutions should be considered in accepting invitations on other than exact eight-year intervals.

5. *Summer Institutes.*

a. *YETs.* Vice President Alexander reported he had received a proposal. It calls for a six-week program for 20 instructors in each of five summers. Families are to accompany the husbands, and wives are to participate in some programs. There are to be three levels of meetings—the entire group, smaller discussion groups, and individual study and research. The staff is to consist of eight highly qualified mature individuals from various fields. The stipend per attendee was set at $1200 plus travel, the total cost per year being estimated at about $60,000. After much discussion it was agreed that the program was desirable but exceedingly expensive. Vice President Alexander was instructed to pursue the matter to determine if a more moderate budget could be prepared, work out additional details, and make inquiries about the interests of foundations in such a program. The relative merits of this program and the proposed study of ways and means to procure and train new faculty members (Item 10) also was discussed.

b. *Humanistic-Social.* Secretary Collins reported that correspondence from Dr. G. A. Gullette indicated that a satisfactory proposal and budget could not be prepared in time for submission to National Science Foundation before 1 September 1956. This may mean that the Summer of 1958 may be the earliest time at which an institute could be held. It is possible that plans may be ready in time for submission to the Executive Board and General Council at the October meetings. President Everitt desig-

nated Vice President Brown to participate in the fund-raising activities.

6. *Guide for Section Reports.* Vice President Lindvall asked for comments on the preliminary form previously sent to members of the Executive Board. It was agreed that Sections should report immediately after their year comes to an end, and that copies of the report should go to the vice President in Charge of Sections and to the Secretary. The Vice President thus has information for his annual report, and the Secretary will have a systematic way of getting the names of new officers and information on other changes or plans.

7. *Membership.*

a. *Air Force Institute of Technology.* The Executive Board VOTED to approve active membership for the Air Force Institute of Technology, both ECAC and ECRC previously having given their approval.

b. *Report of the Associate Institutional Membership Committee.* The annual report stated the committee was strongly opposed to an increase in dues for Associate Institutional Members and that it believed "Industry Members" or some such name is much more desirable than Associate Institutional Member. The Executive Board *VOTED* to refer the proposal to change the name to the Constitution and By-Laws Committee.

c. *Associate Institutional Members.* The Executive Board *VOTED* to approve the membership application of the Goodyear Tire and Rubber Co.

The Executive Board *VOTED* to approve the membership application of the Erie Resistor Corporation.

8. *Report of Atomic Energy Education Committee,* P. N. Powers, Chairman.

a. *1956 Summer Institutes at Argonne and Brookhaven.* The successful programs of the past summer were briefly summarized and it was stated they constituted the basis for future plans. Conferences with students and faculties indicated that attendees were qualified to teach a general elective course on nuclear energy on the undergraduate level, that they could intelligently advise undergraduates interested in nuclear energy, and that they did have concepts about the requirements for nuclear programs in engineering which should enable them to be of value in developing college curricula.

b. *Summer Institutes for 1957.* The shortage of faculty in our colleges of engineering who are trained in nuclear energy requires the repetition of a program similar to the one for 1956. The Executive Board *VOTED* approval of Proposal No. 1 of the Committee, explained in Appendix "A" attached.

Chairman Powers also explained that a second series of courses is needed which would offer specialized work in areas such as reactor physics, reactor materials and metallurgy, instrumentation and control, and chemistry and chemical engineering. This advanced course would be taken by those who had attended this year's general course and by those who have equivalent backgrounds by virtue of formal courses or experience. Those completing the advanced institute course should be able to teach a graduate course in the appropriate area of specialization. The Executive Board *VOTED* approval of Proposal

No. 2 of the Committee, explained in Appendix "A" attached.

The discussion also brought out that these courses should be followed by research in the government laboratories (during summers or on leave of absence) to produce well trained men.

c. *Survey of Manpower.* The committee has been advised by AEC of the need for a nuclear manpower survey in colleges, universities, and other non-profit institutions, and that AEC hoped ASEE would submit a proposal. The survey would parallel those already made for industrial and governmental organizations. The Executive Board *VOTED* approval in principle of Proposal No. 3 of the Committee (explained in Appendix "A"), and authorized the Committee to proceed with AEC negotiations, being certain to include the following items which were believed to be essential to obtain a meaningful and most useful survey:

1. Provision for repetition or follow-up every two or three years.
2. Inclusion of both supply and need data.
3. Distinction between training and education.
4. A very carefully worded questionnaire to distinguish between nuclear science and basic science, solid state physics, etc.

9. *General Council Representation for the ECAC and ECRC Secretaries.* The Executive Board *VOTED* to recommend favorably to the Constitution and By-Laws Committee the proposal that the Secretaries of ECAC and ECRC be ex-officio members of the General Council. The reasons are the need and desire for closer cooperation between the three Councils of the Society and a more rapid exchange of information.

10. *Procurement and Training of New Faculty Members.* President W. L. Everitt stated that the major problem now confronting the colleges of engineering in the United States is the procurement and training of new faculty members to meet the pressures resulting from increasing enrollments. The parallel demand for engineers in industry and governmental organizations also complicates the problem. It is believed the problem can be solved only by means of a thorough study of the procurement and development sources and methods of getting the best staffs possible in the next ten years; quality, quantity, and general preparation all must be considered. President Everitt stated that after informal discussions with most members of the Executive Board, he had presented the proposal to Dean H. L. Hazen of the Massachusetts Institute of Technology and asked him to accept the chairmanship if the project was approved. Dean Hazen accepted. It was thought that the budget would probably be on the order of $50,000–$100,000, that a foundation should be approached for a grant, that the committee would need to prepare objectives, program, and budget, and that high-level people with realistic vision from a variety of areas would be required for the committee. The Executive Board *VOTED* the President authority to proceed with the formation of the committee, and to recommend the proposal favorably to the General Council for approval.

11. *High School Science and Engineering Society.* Deleted.

12. *Suggestions for Long-range Improvement Program in Science Teaching.* President Everitt reported that the matter was now in the hands of the Relations With Secondary Schools Committee of ECAC.

13. *Attendance at Section Meetings.* A list of the known dates for Section meetings was distributed by the Secretary, and general plans for attendance by members of the Executive Board were discussed. The dominating thought was that a member of the Executive Board try to attend each Section meeting. It was agreed that if satisfactory arrangements could be made, the Executive Board would hold its Spring meeting at the time and place of the meeting of the Ohio Section, April 26 and 27. An alternate possibility is with the Middle-Atlantic Section.

14. *Other Business.*

a. *Report from ECRC,* R. J. Woodrow. The committee on Survey of Research Facilities met last week and plans are under way.

b. *Report from ECAC,* W. T. Alexander. An attempt is being made to establish a joint committee with the Association of College Placement Officers to discuss ethics in recruitment. ASEE is directly interested in ethics as it influences students; ECPD should have primary interest in ethics as it pertains to the practicing engineer.

No reply has been received from the Navy Department relative to the proposal that the amount of credit to be given for NROTC work be studied by a joint committee.

c. *Report from Vice President in Charge of Divisions,* C. A. Brown. A meeting of the Divisional representatives on the General Council is being called in conjunction with next month's General Council meeting. The objectives are to improve the quality of the Division programs at the Annual Meeting and to promote stronger liaison with appropriate professional engineering societies.

d. *Report from Vice-President in Charge of Sections,* F. C. Lindvall. No report.

e. *Report of Secretary,* W. Leighton Collins. No report.

f. *Report of Treasurer,* John Gammell. No report.

g. *Continental Casualty Company Insurance Plan.* It was agreed that despite the addition of a Catastrophe Hospital-Nurse-Surgical plan, the Society was not interested in promoting group insurance.

h. *Report of Constitution and By-Laws Committee,* C. A. Brown. Some of the proposed changes in the constitution were presented for discussion in order that the Chairman could have the benefit of the opinions of the members of the Executive Board.

i. *Basis for Determining EJC Dues.* The Secretary reviewed past events and read the following extract from a Memorandum dated September 6, 1956, being considered by the EJC Board of Directors.

> *Article VII—Finances* (new article) Each constituent society shall, not later than November 15th of each year, advise the Secretary of the Council as to its total dues income (for all classes of members, including students) for the twelve-month period ending September 30th of that year. These figures shall be used as the basis for determining the proportionate financial support

of the Council by the constituent societies for the succeeding calendar year in accordance with the provisions of Article VIII—Paragraph 2 of the Constitution.

j. *Educational Television, ACE Letter.* It was agreed the letter be referred to ECAC for determining the extent of ASEE's interest.

k. *NSF Conferences on Mathematics and Science.* President Everitt reported that NSF had about $5,000,000 for programs for high school teachers of mathematics, physics, chemistry, etc., and that he had been asked to submit immediately about eight names for consideration for appointment to a committee responsible for evolving the programs. There will be about 80 summer programs and 16 year-long programs. Several names were suggested.

15. *Next Meeting.* The next meeting of the Executive Board will be a dinner meeting at 6:00 p.m. on Friday, October 26, 1956 at the Engineering Society of Detroit, Detroit, Michigan.

16. Adjournment—5:00 p.m.

Respectfully submitted,

W. LEIGHTON COLLINS,
Secretary

APPENDIX "A"

PROPOSALS TO THE EXECUTIVE BOARD OF THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Presented by Philip N. Powers
on behalf of the ASEE Committee
on Atomic Energy Education
September 15, 1956

Proposal 1:

That the ASEE Nuclear Institute Program, inaugurated during the Summer of 1956 for the benefit of engineering college professors, be extended during the Summer of 1957 for about the same number of participants, and that organization, sponsorship, and administration be along the same lines as before.

Proposal 2:

That three, or perhaps four, more advanced institutes be organized during the Summer of 1957 for individuals who attended one of the ASEE institutes in 1956 or who have the equivalent in training and experience. The courses would be 1) Reactor Physics: Methods and Calculations, 2) Chemistry and Chemical Engineering, 3) Reactor Materials and Metallurgy, and possibly, 4) Instrumentation and Controls.

Background for these Two Proposals:

Because of the need for more engineers with training in nuclear engineering, the ASEE Committee on Atomic Energy Education has initiated several projects to assist engineering colleges in providing the necessary training. This was the purpose of the two ASEE Nuclear Institutes which were held during the Summer of 1956 with the assistance and joint sponsor-

ship of the Atomic Energy Commission and the National Science Foundation. Sixty persons participated in the Institute at Argonne and thirty more at Brookhaven. Costs of presenting the Institutes were borne by the AEC, and the National Science Foundation provided traveling expenses for the participants along with stipends up to about $600 to match corresponding amounts provided by the college or university involved.

The Committee on Atomic Energy Education has made a detailed evaluation of both of these Institutes and is convinced that they were highly successful.

The Committee believes that not only should this same opportunity be extended to other engineering college professors, but that more advanced experience will be necessary in a great many cases. It is recognized that a professor must have more than an introduction to the concepts of nuclear technology if he is to offer useful instruction to students in the field. This higher-level ability can be gained by an interested professor in a number of ways, one of which, of course, is to participate in a more advanced nuclear institute. As in any field, however, as more thorough instructional coverage is provided, the scope encompassed by one course, and by any one student, becomes more restricted, particularly in nuclear technology which deals with unusually wide technical areas. Development of proficiency should hardly be attempted at the beginning in more than one of the more specific fields comprising the whole practice of nuclear engineering.

Hence, in providing practical assistance to seriously interested professors, the Committee proposes to make available in the Summer of 1957 one advanced institute in each of three or perhaps four of the most important component fields of nuclear engineering.

Subject Matter for Advanced Institutes:

1. *Reactor Physics: Methods and Calculations:* The concepts and appropriate practices of calculating the necessary nuclear characteristics required in designing a reactor will be developed. Such topics will be included as critical dimensions and quantities, fluxes, reactivity values, control rods, time response behavior, safety factors, and shielding. It will be assumed that the student is familiar with the general features of reactors and has a command of calculus, with some ability to handle the solution of differential equations.

2. *Chemistry and Chemical Engineering:* The emphasis here will be on the engineering applications of chemistry (in contrast with research applications) to the practical problems of nuclear practice: chemistry of reactor systems, separations, procedures and processes, corrosion problems, and radiation effects.

3. *Reactor Materials and Metallurgy:* Mechanical engineering problems of reactor design, choice of materials based on examination of nuclear properties, heat transfer, and chemical problems. Fuel element principles and practices, effects of radiation, and related problems will be discussed.

4. *Instrumentation and Controls* (the importance of this material for a separate Institute is still under discussion; content is therefore not specified).

In each Institute, appropriate laboratory experiments will be coordi-

nated with the course material. Actual problems will be worked out, and significant "homework" assignments will be made.

Administration and Supervision:

Each course will be six or eight weeks in duration, and will be located at a national laboratory or other institution having adequate facilities, where the staff (augmented as necessary) will have responsibility for providing instruction.

It is intended that financial support, including stipends and travel expenses for selected professors, staff reimbursement, and administrative coordination, will be provided by the Atomic Energy Commission. Where the Institute is located at a national laboratory, budget allocation for the cost of operating the school would probably be made directly to the laboratory (with provision of necessary expenses of the Atomic Education Committee being included). If a course is offered by some other institution, e.g., a school, funds may be granted to the ASEE. Funds for travel expenses and individual stipends would be granted to the ASEE and then distributed to an administration agency selected for the purpose. (Northwestern University provided this service for the Argonne Institute.)

The Committee on Atomic Energy Education will assist the selected organization in planning, participate in selecting the students, and maintain close contact with the development and progress of each Institute.

Co-sponsorship of the National Science Foundation appears desirable again, even though funds are likely to come from the AEC this time.

Direction of these projects for the Committee would be by Dr. Clifford Beck, who serves as Chairman of a Subcommittee for this purpose. He is now located in Washington and is therefore in a good position to maintain close liaison with the AEC.

Student Selection:

The enrollment in each of the three Advanced Institutes will be limited to thirty-five students. Only one staff member from a given institution may enroll in each course; but encouragement should be given for a participating school to enroll a member in at least two courses, thus the capacity of a school to offer effective instruction to students would be increased.

Each applicant selected should be expected to have an acquaintance with nuclear technology, at least the equivalent of that provided in the 1956 Institutes at Brookhaven and Argonne.

Budget:

A detailed budget will be worked out in cooperation with institutions selected to administer the Institutes, but the costs of stipends and travel expenses were expected to be approximately $800 per person during this last Summer.

Procedure:

If these two proposals are approved, the next step will be to send a letter from President Everitt to Chairman Strauss of the AEC and a parallel letter to Dr. Waterman of the National Science Foundation in which these proposals are formally submitted.

Proposal 3:

That ASEE undertake for the AEC a nuclear manpower survey in colleges and universities, and other nonprofit research institutions.

Background for Proposal 3:

The ASEE Committee on Atomic Energy Education has been advised by the AEC that a survey of this kind is needed and that the AEC hopes ASEE will submit a proposal to carry it out. The Committee agrees with the AEC that an evaluation of the needs for engineers and scientists is required for the proper planning and growth of our atomic energy programs. One phase of this evaluation is concerned with universities, colleges, and other non-profit research institutions. Information is required on the supply of and needs for engineers and scientists engaged in teaching and research in areas directly related to nuclear engineering and science. The Committee feels further that it is appropriate and desirable, for a professional organization such as the ASEE to undertake this survey for the Atomic Energy Commission.

Collaboration with other Interested Professional Groups:

The survey will cover activities in the sciences as well as in engineering and, therefore, collaboration will be sought with the AAAS, American Nuclear Society, Scientific Manpower Commission, and the Engineering Manpower Commission. It is expected that the collaborations will be limited to consultations on the details of the questionnaire to be sent to the universities, colleges, and other institutions. The initiative and direction of the survey will remain with ASEE.

Director of the Survey:

It is proposed that Professor Lee V. McLean, Department of Electrical Engineering, Louisiana State University, Baton Rouge, will undertake this project. He will seek the advice of Dr. P. Morton, National Science Foundation, for the formulation, solicitation, and analysis of the questionnaire. A preliminary draft of the questionnaire will be submitted to the other groups noted for collaboration. Pre-test of the questionnaire also will be undertaken. A detailed questionnaire will be sent to some 200 schools that have demonstrated interest in nuclear engineering and science. A very simple questionnaire will be sent to some 800 additional schools to uncover additional activity which can then be probed more thoroughly.

The assistance of the commerce school at Louisiana State University will be sought in analyzing the statistics of the survey.

The effectiveness of the survey is dependent upon a high rate of response, and every effort will be made to insure the success of this undertaking. Several trips will be undertaken for this purpose.

Budget:

The total budget estimated for undertaking this survey is $6600, consisting of $1600 for travel; $3000 for secretarial assistance, printing, postage, telephone, and other expenses; and $2000 for professional staff services. All the work is to be done at Louisiana State University under the direction of Professor McLean.

Procedure:

If this project is approved, the next step will be to advise Professor McLean of the fact and to develop, with his collaboration, a formal letter of proposal from President Everitt to Chairman Strauss of the AEC.

NEW MEMBERS OF THE ASEE

ARMSTRONG, B. J., Engineering Staff Analyst, Engineering Department, Chance Vought Aircraft, Dallas, Texas. A. I. Sibila, G. E. Smith.

BACKER, STANLEY, Associate Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts. M. M. Boring, M. E. Norton.

BOUCHER, ROBERT XAVIER, Supervisor Training Officer, Co-ordinator Cooperative Engineer, National Security Agency, Rogers Heights, Maryland. W. R. Rooney, R. G. Kloeffler.

BURTON, ROBERT M., Instructor in Engineering Drawing, General Motors Institute, Flint, Michigan. E. D. Black, H. M. Dent.

CAIN, ROBERT WILLIAM, Chief Scientific and Technical Occupations, Bureau of Labor Statistics, Springfield, Virginia. D. C. Metz, M. M. Boring.

CAVANAUGH, WILLIAM T., Executive Secretary, Engineers Joint Council, 29 W. 39th Street, New York, New York. D. C. Metz, M. M. Boring.

COLLAR, BURLYNN EVERETT, Engineering Examiner, Michigan Civil Service Commission, Lansing, Michigan. F. P. Kelly, W. L. Collins.

COOPER, CARROLL W., Engineering Personnel Representative, Engineering Department, Convair-Fort Worth, A Division of General Dynamics, Fort Worth, Texas. J. W. Hoffman, J. E. Dahlman.

CORCORAN, WILLIAM H., Associate Professor of Chemical Engineering, California Institute of Technology, Pasadena, California. F. C. Lindvall, G. D. McCann.

DONOVAN, THOMAS JAMES, Personnel Representative, Engineering Department, E. I. du Pont de Nemours & Co., Wilmington, Delaware. J. B. Moulton, H. M. Miller.

ENGEBRETSON, HELEN, Associate Professor of Mathematics, South Dakota State College, Brookings, South Dakota. K. E. Lindley, W. H. Gamble.

FAHIEN, RAYMOND W., Assistant Professor of Chemical Engineering, Iowa State College, Ames, Iowa. D. R. Boylan, Morton Smutz.

FONCANNON, HOWARD FRANK, Project Director, Scientific Manpower, National Science Foundation, Washington 25, D. C. D. C. Metz, M. M. Boring.

FRANK, NATHANIEL HERMAN, Head, Department of Physics, Massachusetts Institute of Technology, Cambridge 39, Massachusetts. C. E. Tucker, K. L. Wildes.

GABRIELE, THOMAS CARMEN, Instructor in Electrical Engineering, Milwaukee School of Engineering, Milwaukee, Wisconsin. W. A. Van Zeeland, R. J. Ungrodt.

GENTRY, CALVIN B., Administrative Assistant, University of Houston, Houston, Texas. A. Ray Sims, Roy J. Dossat.

GLASS, ELWOOD GRAY, JR., Coordinator of Recruitment, Industrial Relations, The Standard Oil Co., Cleveland, Ohio. J. V. Perdue, S. J. Hirschfield.

GOUDEY, GORDON M., Instructor in Engineering Drawing, Newark College of Engineering, Newark, New Jersey. F. J. Burns, M. R. Weller.

HAERTEL, DAVID GEORGE, Instructor in Electrical Engineering, Milwaukee School of Engineering, Milwaukee, Wisconsin. W. A. Van Zeeland, R. J. Ungrodt.

HIGGERSON, CHARLES A., Senior Instructor, Mechanical Department, Mohawk Valley Technical Institute, Utica, New York. R. W. Miller, L. J. Sitterlee.

INGALLS, EDMUND ELLSWORTH, Professor of Mathematics, Albion College, Albion, Michigan. G. G. Brown, W. J. Emmons.

ISLAM, NURRUDIN TAUFIQUE-UL, Head of Mechanical Engineering Department,

E. B. Polytechnic Institute, Dacca, East Pakistan. H. P. Adams, E. M. Barnes.

KELLOGG, FREDERIC H., Dean of the School of Engineering, University of Mississippi, University, Mississippi. F. A. Anderson, H. B. Kerr.

KUHNS, JAMES LEE, Educational Coordinator, Engineering Department, Boeing Airplane Company, Wichita, Kansas. A. P. Bailey, John Ruptash.

LEE, SHIH-YING, Assistant Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts. M. M. Boring, D. E. Irwin.

LITTLE, FRED H., Development Engineer, Hughes Tool Co., Houston, Texas. A. P. McDonald, D. E. Schiller.

LOFY, FRANCIS JOSEPH, Instructor in Electrical Engineering, Milwaukee School of Engineering, Milwaukee, Wisconsin. W. A. Van Zeeland, R. J. Ungrodt.

LONGACRE, ANDREW, Professor of Physics, University of Illinois, Urbana, Illinois. W. Leighton Collins, W. L. Everitt.

MERCHANT, WILLIAM H., Coordinator, Cooperative Training Department, Redstone Arsenal, U. S. Army, Huntsville, Alabama. J. G. Wohlford, P. Carlstone.

MCMAHON, JOHN F., Dean, State University of New York College of Ceramics, Alfred, New York. R. M. Campbell, G. F. Burdick.

OEST, IRWIN W., Professor, Engineering Extension, Iowa State College, Ames, Iowa. G. R. Henninger, W. Leighton Collins.

OSGOOD, WILLIAM R., Professor and Head of Mechanics Department, Rensselaer Polytechnic Institute, Troy, New York. R. H. Trathen, J. F. Throop.

PARTIN, WILLIAM, Head, Electronics and Refrigeration, Institute of Technology and Art, Calgary, Alberta, Canada. E. W. Wood, T. J. Rung.

QUACKENBOS, H. MAXWELL, Personnel Administrator, Development Department, Bakelite Company, Bound Brook, New Jersey. H. E. Hoelscher, E. Weger.

RINGE, DONALD ARTHUR, Assistant Professor of English, University of Michigan, Ann Arbor, Michigan. S. S. Attwood, T. Farrell, Jr.

ROBERTS, DONALD S., Manager, Education and Training Department, General Electric Company, Richland, Washington. D. W. McLenegan, R. E. Curtis.

ROGOWSKI, AUGUSTUS R., Associate Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts. J. Kaye, J. H. Keenan.

ROWLEY, GEORGE SLOAN, Assistant Professor, Mathematics and Science Department, Tri-State College, Angola, Indiana. A. A. Hockey, P. A. Nurnberger.

SAUNDERS, DAVID R., Research Associate, Research Department, Educational Testing Service, Princeton, New Jersey. D. S. Bridgman, W. L. Collins.

SCHWAB, GLENN O., Professor of Agricultural Engineering, Ohio State University, Columbus, Ohio. J. K. Vennard, R. M. Kerchner.

SENSEMAN, WILFRED M., Professor of English, University of Michigan, Ann Arbor, Michigan. Thos. Farrell, Jr., W. J. Emmons.

SMITH, PAUL L., JR., Instructor in Electrical Engineering, Carnegie Institute of Technology, Pittsburgh, Pennsylvania. L. Depian, A. T. Murphy.

SOMMER, HAROLD J., Assistant Professor of Mechanical Engineering, University of Dayton, Dayton, Ohio. J. H. Parr, A. R. Weber.

STONE, GERALD P., Associate Professor of Mechanical Engineering, Polytechnic Institute of Brooklyn, Brooklyn, New York. R. F. Bitner, J. R. Curreri.

TOWER, MERRILL E., Counselor, Northrop Aeronautical Institute, Inglewood, California. C. T. Reid, J. L. McKinley.

TUTHILL, SIDNEY P., JR., Instructor in Engineering Drawing, Syracuse Uni-

versity, Syracuse, New York. G. W. Walsh, Jr., C. P. Buck.

WEBB, V. H., Editor, The Macmillan Company, New York, New York. H. B. McCurdy, E. M. Williams.

WILEY, GORDON E., General Personnel Supervisor, New York Telephone Company, Albany, New York. D. S. Bridgman, D. R. McGuirk.

WILLIAMS, MILO RYAN, Associate Professor, Mechanical Engineering Department, Tennessee Polytechnic Institute, Cookeville, Tennessee. J. M. Henderson, J. S. Brown.

WILLSON, CLARENCE A., Research Engineer, American Iron and Steel Institute, 150 East 42nd Street, New York, New York. C. E. Kesler, W. M. Lansford.

50 new members
85 previously added
---
135 new members this year

NEWSOM FOLLOWS HEALD AS HEAD OF NEW YORK UNIVERSITY

Professor Carroll V. Newsom, a member of ASEE since 1943, has been appointed President of New York University. Executive Vice-President of the University since July, 1955, Dr. Newsom succeeds President Heald, who becomes President of the Ford Foundation. Dr. Heald, a member of ASEE since 1931, served as the Society's President, 1942 to 1943; Vice-President, 1941–1942, and a Member of the Council, 1938 to 1947.

GRAETZER APPOINTED DEAN

Gunther R. Graetzer, a member of ASEE since 1948 and Professor and Head of the Department of Aeronautical Engineering at the United States Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio, has been appointed Dean of the School of Engineering at the Institute. He succeeds Reginald H. Downing, a member of the Society since 1952, who has advanced to Director of the Resident Instruction Division.

TEACHING POSITIONS AVAILABLE

THREE MECHANICAL ENGINEERS, one Nuclear Engineer to teach machine design, metallurgy, heat power, aeronautical option, nuclear option or some combination of these fields. M.S. required, Ph.D. desirable. Assistant Professor to Department Chairman. Rank and salary commensurate with qualifications. Opportunities for year-round teaching on co-op program. Write Dean Earl H. Flath, School of Engineering, Southern Methodist University, Dallas 5, Texas.

CHEMICAL ENGINEERING ASSISTant Professor for department fully accredited by E.C.P.D. and A.I.Ch.E. Ph.D. preferred. Opportunities for industrial consulting and project supervision in Engineering Experiment Station. Appointment February 1 or September 1, 1957. Apply, giving full details, to A. Ralph Thompson, Head of Chemical Engineering Department, University of Rhode Island, Kingston, R. I.

PROFESSOR AND HEAD OF MATHematics Department needed. Opportunity to develop an outstanding department in a school of engineering for a young man with a Ph.D. in mathematics, or engineering with a minor in mathematics. A sympathetic viewpoint toward progressive engineering education. Some experience in teaching or research associated with science or engineering are desirable. Also Professor and head of Mechanical Engineering Department position available. Opportunity for a young man, 28 to 40, holding a Ph.D. in Mechanical Engineering or allied field to develop first rate department. Experience in teaching, industrial or other appropriate area desirable. Salary for academic year of ten months comparable to industrial compensation. Write to Dean of Engineering, Pratt Institute, Brooklyn 5, N. Y.

ASSOCIATE OR ASSISTANT PROfessor needed to lead academic program in structures. M.S. or Ph.D., industrial experience desirable. Opportunity for research. Man desired March or September, 1957. Also Research Engineer in irrigation, principally ground water. M.S. or Ph.D., field experience desirable. Limited teaching. Salaries dependent upon qualifications. Location Colorado. NOV-1.

ENGINEERING INSTRUCTORS, INcreased enrollment requires teaching staff expansion creating several openings soon for industry-experienced men, with or without teaching experience, to serve as instructors in the various phases of practical Aeronautical Engineering. Retired or semi-retired persons desiring California residence and light workload can be employed for as little as two or three hours per day. American citizenship not required. Leaflet of full particulars about the kind of teaching, also the school catalog, will be furnished upon request. Send replies to: C. T. "Tom" Reid, Director of Public Relations, Northrop Aeronautical Institute, 1155 West Arbor Vitae Street, Inglewood, Calif.

ELECTRICAL AND MECHANICAL Engineering staff openings at Ph.D. and M.S. levels. Salaries commensurate with qualifications. Apply to: Dean, College of Engineering, Duke University, Durham, North Carolina.

ASSISTANT OR ASSOCIATE PROfessor of Civil Engineering to teach undergraduate and graduate courses in structural engineering. M.S. degree required. Salary and title dependent upon qualifications of applicant. Position available January 1, 1957. Write to Chairman, Civil Engineering Department, N. D. State College, Fargo, N. D.

METALLURGICAL ENGINEERING position for Assistant Research Professor. Duties include supervision of research assistants. Opportunities for teaching specialized courses. Immediate appointment. Salary commensurate with qualifications. Send resume to Dean T. Stephen Crawford, College of Engineering, University of Rhode Island, Kingston, R. I.

VISITING LECTURER OF ASSOCIate Professor level needed on January 2, 1957. Must be graduate of accredited Industrial Engineering curriculum and have 5–10 years industrial and teaching experience. Will be required to teach statistical quality control, factory planning, engineering economics, etc. Opportunities available to teach night course and to conduct private consulting practice. Good opportunity for advancement. Write to Director, Department of Industrial Engineering, University of Puerto Rico, College of Agriculture and Mechanics Arts, Mayaguez, Puerto Rico.

ASSISTANT OR ASSOCIATE PROfessor in Industrial Engineering. Need experienced man from diversified industries in production planning and control, tooling and mechanization, and other production areas. Cooperative industries assist research facilities in these areas. Advanced degrees helpful. Excellent-consulting opportunities, beautiful campus, 9 month contract, salary open. Some teaching experience desirable; can develop new courses. Write to Department of Industrial Engineering, Washington University, St. Louis 5, Missouri.

ASSISTANT PROFESSOR OR INstructor to teach Sanitary and other Civil Engineering subjects. M.S. preferred, but B.S. degree considered. Salary dependent upon qualifications. Immediate appointment available. Write to Head, Civil Engineering Department, University of Akron, Akron 4, Ohio.

INSTRUCTOR OR ASSISTANT PROfessor to teach mechanics, dynamics, vibrations, stress analysis. Master's degree and some industrial experience preferred. Mechanical Engineering Department, Oregon State College, Corvallis, Oregon.

ASSOCIATE AND ASSISTANT PROfessors for fields of advanced strength of materials, elasticity, dynamics and fluid mechanics. Start February or September. Department of Applied Mechanics, University of Kansas, Lawrence, Kansas.

HEAD OF MECHANICAL ENGIneering Department. Should have both teaching and industrial experience. Write to E. W. Kimbark, Dean, School of Engineering, Seattle University, Seattle 22, Washington.

CIVIL ENGINEER WITH B.S. OR M.S. for teaching. Salary and rank depend upon qualifications. One position for February 1, 1957, or earlier; two others for September 1. Apply to Chairman of Civil Engineering, University of Nebraska, Lincoln.

ASSOCIATE AND ASSISTANT PROfessors and Instructors in Electrical and Mechanical Engineering. Permanent opportunity in expanding programs. M.S. degree desirable. Fellowships available for part-time graduate work in state university at M.S. level. Please forward complete details of education, practical experience, and personal background to Dean of Engineering, Milwaukee School of Engineering, Milwaukee, Wisconsin.

INSTRUCTORS IN GENERAL ENGIneering drawing, either in drafting or descriptive geometry. Engineering degrees preferred. Also instructor in civil engineering and mechanics, or in mechanics. Salaries for nine-month academic year based upon teaching experience and education. Both positions lead to permanent appointments. NOV-2.

SUPPLY AND NEED OF SCIENTISTS AND ENGINEERS 1955-1965

The Manufacturing Chemists' Association, Inc. has prepared a study of the nation and chemical industry's needs for technical and scientific graduates during the ten year period 1955–1965. The expected graduations have been compared with the anticipated needs for scientists which will be necessary to continue our past economic growth and to maintain an adequate national defense. The results of this analysis can be summarized briefly as follows:

New graduates in science and engineering, 1955–65	674,000
Losses from technical labor force, 1955–65	335,000
Net increase in technical labor force, 1955–65	339,000
Needed increase in technical labor force, 1955–65	796,000
Indicated cumulative deficit in technical labor force, 1965	457,000

Copies of the seven-page pamphlet can be obtained by writing to the Manufacturing Chemists' Association, Inc., 1625 I Street, N.W., Washington 6, D. C.

ADDED MATHEMATICS GUIDANCE PAMPHLET

The Mathematical Association of America, with headquarters at the University of Buffalo, has supplied information about their career bulletin, "Professional Opportunities in Mathematics." Twenty-four pages in length, designed originally for college students but widely distributed to high schools also, the report includes discussions of possibilities and requirements for teaching, statistical analysis, industrial and government applications, and actuarial uses, plus references for further reading. Some 20,000 copies of the first (1951) and second (1954) edititions have been applied in counseling work, according to the Association, and a third edition is now being prepared. Cost of the publication is 25¢ for single copies, 10¢ each for ten or more. Orders should be sent to Harry H. Gehman, Secretary-Treasurer, Buffalo 14, New York. (See also other similar entries, JOURNAL, June, 1956, p. 858; it has been suggested that items I and 10 of the original list are intended primarily for college students, though useful for high school groups as well.)

ADDITIONAL ASEE COMMITTEES

IDEAL REGISTRATION LAW (*ad hoc*): J. H. Sams, *Chairman*, Clemson A. & M. College, Clemson, S. C.; G. F. Branigan; K. F. Wendt.

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From the Technical Institute Division: G. R. Henninger; G. F. Maedel; A. R. Sims.

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E. J. Craig, Union College, Schenectady, New York

AMERICAN SOCIETY FOR ENGINEERING EDUCATION

NOMINATION BLANK

"ARTICLE XI, Section 3. (Election of Officers) By means of a form to be printed in The Journal of Engineering Education or in the preliminary program of the annual meeting, an opportunity shall be given to individual members of the Society to submit names of persons to be considered for said officers. These names, on the form provided, shall be sent to the Secretary of the Society not less than sixty (60) days prior to the annual meeting; and the Secretary shall submit the suggested names to all members of the Nominating Committee."

In order to make the election of officers of the Society as democratic as possible, members are urged to fill out the nomination form and return before March 1, 1957 to the Secretary, W. Leighton Collins, University of Illinois, Urbana, Illinois.

I nominate the following members of the Society for officers:

For President .....

.....

For Vice-President .....
(*In Charge of General and Regional Activities—two years*)

.....

For Treasurer .....

.....

Signed .....

Title .....

Institution .....

Date .....

ASEE CALENDAR OF EVENTS, 1956–1957

Meeting	*Date*	*Location*	*Chairman or Information*
National Capital Area Section	Oct. 2	National Science Foundation	W. J. Huff, U. of Md.
Upper New York-Ontario Section	Oct. 13–14	Union College	W. H. Branch, General Electric Co. R. B. Russ, Union College
New England Section	Oct. 19–20	Tufts University	W. S. Evans, U. of Maine
Middle Atlantic Section	Dec. 1	Cooper Union	E. M. Griswold, The Cooper Union New York City
Pacific Southwest Section	Dec. 27–28	University of Arizona	D. Whelan, Loyola U. of L. A.
Relations With Industry Division, College-Industry Conference	Jan. 30–31	University of California (Los Angeles)	C. Muhlenbruch, Educational & Technical Consultants
Cooperative Engineering Education Division	Jan. 10–11	Northeastern University	E. Hamlen, U. of Akron
Engineering Drawing Division	Jan. 30–Feb. 1	Rice Institute	I. L. Hill, Ill. Institute of Technology
Missouri-Arkansas Section	April 6	University of Arkansas	L. R. Heiple, U. of Arkansas
Southwest Section	April 18–19	Texas A. & M. College	E. M. Thomas, Texas Western
Allegheny Section	April 26–27	Penn State University	B. A. Whisler, Penn State U.
Ohio Section	April 26–27	University of Toledo	E. D. Harrison, U. of Toledo
Rocky Mt. Section	April 27	Brigham Young University	B. Brown, Brigham Young U.
Southeastern Section	April 4–5	Brown Hotel Louisville, Ky.	M. Baker, U. of Kentucky
Michigan Section	May 4	General Motors Institute	C. L. Fanning, General Motors Institute
Pacific Northwest Section	May	Washington State College	M. C. Jenson, Washington State College
Illinois-Indiana	May 17	Northwestern U.	O. W. Eshbach, Northwestern U.
ASEE ANNUAL MEETING	JUNE 17–21, 1957	CORNELL UNIVERSITY	J. C. Gebhard